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First-Class Steerage

It has recently been suggested that there exist people who, for a fee, pilot applications for various sorts of licences through the maze of Government departments. Rightly or wrongly, such activities are viewed with suspicion. In the ironfoundry industry, the need for such individuals is non-existent, because since January 1 this year, the Council of Ironfoundry Associations has undertaken, through a series of regional steering committees, the rôle of agent, *vis-a-vis* with the Iron and Steel Board. This, of course, was in respect to the acquiring of licences for new buildings, plant extensions, amenities and the like. As for other allied activities, this Association has given service ever since its inception.

We doubt if this activity, initially, was generally appreciated, because, like all agencies, it had to satisfy two parties. With the passage of time, and personal experience of the work of the steering committees, applicants became convinced of the efficiency of the system. Mr. FitzHerbert Wright, in a speech to a large gathering of ironfounders, spoke at considerable length on this subject, pointing out that applications for licences, to be successful, must be set down, initially, in a form acceptable to the Iron and Steel Board. We call to mind the personal acquisition of a licence to buy a Thermos-flask cork, by associating its use with a means of dispensing hospitality to overseas buyers visiting our office! In addition to "form of presentation," there were often difficulties in interpreting just what the applicant sought, and in such and similar cases a member of a steering committee has personally visited the applicant's foundry. Here, again, we find it desirable to stress that foundry concerns have but a very limited number of competitors. It is recorded that after a visit to one concern, the steering committee changed its views to accord with the applicant's plans. A striking statement by Mr. FitzHerbert Wright was that "it is true to say that hardly one small foundry knows how the other small foundry is going on." We are convinced that a visit by a knowledgeable foundryman to another founder's shop is invariably productive of much good. Indeed, it could hardly be otherwise.

For the first three quarters of this year, of the hundreds of applications filed, about 78 per cent. were approved by the steering committees, and of these 97 per cent. received the approbation of the Iron and Steel Board. The total cost of these schemes is of the order of £2 million. The bulk of the work sanctioned is for modernisation rather than for additional production. This is interesting, for a 10 per cent. recession in trade would, at the current output of the industry, reduce the consumption of pig-iron and scrap by 325,000 tons. Since October, 1946, however, the grand total sanctioned is £5¼ million. Of interest to the many hundreds of quite small ironfoundries is the following quotation from Mr. FitzHerbert Wright's speech: "In recent weeks we investigated the case of an ironfounder, which was a genuine case of a service foundry meeting local conditions, and this ironfounder had a personnel of four—himself, his son and two relatives. His wife kept the books. This particular case was one in which the owner was being evicted from his premises and had been found an alternative site by the local authorities, and was spending a few thousands on a new foundry." The members of the steering committees have well merited the trust imposed on them and, now, the appreciation of their work, so widely proclaimed, is consonant with the hard work undertaken. By their help, "steerage" has become "first-class."

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International Foundry Congress, 1949, in the Netherlands

It is announced from Amsterdam that it is intended to hold the International Foundry Congress, 1949, in the Netherlands. The congress will take place in the week of August 29 to September 3, 1949. An organising committee has been appointed under the chairmanship of Ir. A. Baron Krayenhoff; the President and secretary of the Netherlands Foundrymen's Association; Ir. F. G. Jüngeling and C. F. can Dam have provisionally agreed to sit on this committee.

A committee for editing the technical contributions has also been appointed, consisting of Prof. Dr. Ir. W. F. Brandsma and Drs. A. Ph. Krijff.

It is intended that the Congress will have for its main themes:—(1) Non-destructive testing; (2) the possibility of the international standardisation of moulding sand testing; (3) the mechanisation of foundries, and (4) the widening of the knowledge of construction of non-ferrous melting furnaces. In addition, every important contribution in the field of iron, steel, and non-ferrous practice will be welcome.

It is expected that, amongst others, all member countries of the *Comité International des Associations de Fonderie* will take part in the Congress.

Papers must reach the secretary of the Technical Contributions Committee, Drs. A. Ph. Krijff, Emmalaan 7, Nijmegen, before May 1, 1949. In order to obtain a general picture of the probable extent of the contributions, each contributor is requested to inform Drs. Krijff as soon as possible, as to the subject and probable extent of his Paper. The date of May 1, 1949, cannot be extended, as translating and editing of Papers will require a considerable time. The official languages of the Congress are Dutch, English and French, and eventually German. It is necessary in each case to provide a summary in English or French with the Paper.

MR. JAMES R. RICHARDSON, whose name figured in the list of new members elected to the Institute of British Foundrymen, is the proprietor of the firm of James R. Richardson, of 73, Pershore Road, Edgbaston, Birmingham, 5, and is not of R. J. Richardson & Sons, Limited, as was stated. We regret the error.

AT THE LONDON LOCAL SECTION of the Institute of Metals, 4, Grosvenor Gardens, S.W.1, on January 6, the film, "A Story of Copper," will be shown as a background to a talk by Dr. E. Voce, Ph.D., M.Sc., F.I.M., on modern developments in the production and application of copper and copper alloys.

SCOTTISH EXPERIMENTS in the addition of oxygen have been under way for some time, and the Balbardie Steel Works of the North British Steel Foundry, Limited, Bathgate, decided to incorporate the new technique in their Tropenas converters. Many castings of a fine, thin, and intricate nature are made at the works, and the more fluid metal resulting from higher operating temperatures will flow more easily into the moulds.

Forthcoming Events

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

DECEMBER 7.

Chemical Engineering Group.

"Radiation Hazards and their Control," by Dr. E. F. Edson, in the apartments of the Geological Society, Burlington House, London, W.1, at 5.30 p.m.

DECEMBER 8.

Institution of Production Engineers.

Birmingham Section:—Christmas Party and Dance, at the Grand Hotel, Birmingham.

Institute of Vitreous Enamellers

Southern Section:—"Sign and Stencil Cutting and Screen Work,' by S. H. Ryder, at the Charing Cross Hotel, London, W.C.2, at 7.15 p.m.

DECEMBER 9.

Institute of British Foundrymen.

London Branch:—Joint Meeting with the London Section of the Institute of Metals. "The Solidification of Metals, with Special Reference to Continuous Casting Processes," by Dr. E. Shener, at Grosvenor Gardens, London, S.W.1, at 7 p.m.

East Anglian Section:—"Special Moulds," a symposium at the Central Library, Ipswich, at 7 p.m.

Institution of Production Engineers.

Cornish Section:—"Fabrication Design as a Substitute for Casting," by F. G. Rout.

DECEMBER 10.

Institute of British Foundrymen.

Middlesbrough Branch:—"Problems of Contraction and Distortion in Iron Castings," by E. Longden, at the Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, at 7.30 p.m.

Lincoln Section:—"New Grades of Cast Iron and their Applications," by Dr. A. B. Everest, Ph.D., B.Sc. Joint meeting with Lincoln Engineering Society, at the Lincoln Technical College, at 7.15 p.m.

West Wales Section:—"Gates and Risers." Films and slides presented by Gordon Jones, at Nevills' canteen, Llanelly, at 7 p.m.

Royal Statistical Society—Industrial Applications Section.

London Group:—"The Functioning of a Statistical Department in the Steel Industry," by A. W. Swan, at the E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, London, W.C.2, at 6 p.m.

Institution of Production Engineers.

Eastern Counties Section:—"Material Handling," by H. M. King, at Britannia Works, Colchester, at 7.30 p.m.

Keighley Association of Engineers

"Industrial Applications of High-frequency Heating," by J. E. Payne, B.Sc., at Devonshire Buildings, Keighley, at 7.30 p.m.

DECEMBER 11.

Institute of British Foundrymen.

Bristol and West of England Branch:—"Light-alloy Founding," by E. Raybould, at the Grand Hotel, Bristol, at 3 p.m.

Scottish Branch:—"Manganese Bronze Propellers," by F. J. Tector, B.Eng., and J. Martland, at the Royal Technical College, Glasgow, at 3 p.m.

Lancashire Branch:—"Some Aspects of the Joint Advisory Committee Report on Conditions in Ironfoundries," by J. W. Gardom, F.I.M., at the Engineers' Club, Albert Square, Manchester, at 3 p.m.

East Midlands Branch:—"Some Solved and Unsolved Problems in the Metallurgy of Black-Heart Malleable," by Dr. Schwartz (the Edward Williams Lecture), to be presented by A. E. Peace, at the School of Arts and Crafts, Derby, at 6 p.m.

Newcastle Branch:—"Core-making," by J. Gilbert, at the Neville Hall, Newcastle-upon-Tyne, at 6 p.m.

Will any reader knowing the address of the makers of the Griffin ladle as used by die casters please communicate with the Editor.

Metallising in Relation to Foundry Practice*

Equipment, Methods and Applications

By J. Barrington Stiles, M.I.Mech.E., M.I.Mar.E.

Metal spraying is a process that can easily and advantageously be employed by a foundry, and it will yield consistently reliable results for a wide variety of applications if the proper technique be used and the limitations of the process understood. This Paper seeks to describe some of the commoner applications of metal spraying in connection with foundry work, and for those whose interest may have been aroused, goes on to explain the operation of modern metallising equipment. It has been necessary to include information concerning the physical characteristics of sprayed metal, a knowledge of which is essential to those who would determine whether metallising may be relied upon to produce the required results in any particular instance.

Foundry Applications

There are two main classes of metallising work. On the one hand, there is the broad field of applying protective metal coatings. Historically at least, this aspect of metallising deserves some priority, since it provided the original *raison d'être* of metal spraying. The second class of metal spraying, in which the process is used for building up under-size parts, repairing defects in components, and generally modifying the size or shape of an object, is one which may be equally important in a foundry.

Coating Work

The wide range of metals and alloys which may be sprayed (including any metal which is obtainable in wire form) renders metallising an extremely flexible agent for coating work. The most general use of a metallic coating, particularly on iron or steel, is to provide protection against corrosion, and since the best results are obtained by using a coating metal which is anodic to the material being protected (*i.e.*, a metal which will sacrifice itself rather than allow the base material to be attacked), zinc or aluminium is the material usually employed for coating work. There is considerable prejudice in favour of zinc for this purpose, no doubt as a result of the long and satisfactory experience of zinc coatings applied to steel by various processes. It would not be true to state that zinc is superior to aluminium for the protection of steelwork under all conditions, however; in fact, aluminium under some circumstances, gives very much better results than zinc, due to the fact that aluminium oxide is practically insoluble in water, whereas zinc oxide is readily soluble.

Zinc, if not protected by subsequent painting, forms an oxide which may be dissolved so as to re-expose the metallic zinc. With some industrial and marine atmospheres, the protection afforded by aluminium is markedly superior to that of a zinc coating of equal thickness, and the facility with which either metal may be employed illustrates the great flexibility of this process in the matter of permitting the most appropriate metal to be employed for a particular purpose. There is very little difference in the cost of spraying with zinc or aluminium, and since the foundry user can carry out the work in his own shop, it is often found competitive in price with galvanising, while the coating thickness applied may be such as to give a far greater expectation of life than would be possible by galvanising. Other things being equal, the life of a zinc or aluminium coating is determined by its thickness, which may vary in the case of zinc from approximately 0.001 in. to 0.015 in., and in the case of aluminium from 0.003 in. to the same maximum. Cadmium is used in a few cases to provide an anodic coating to steel and iron, but is limited by the much higher cost of cadmium compared with zinc or aluminium.

In addition to these anodic coatings, protection of steel and iron is quite commonly achieved by using metals which are cathodic to iron, the commonest being tin and lead. Both these metals have to be employed with care, since whereas the anodic coatings will tend to seal themselves off in service, any pinholes or porosity in lead or tin coatings result in rapid attack of the base material thus exposed. It is, therefore, quite common to finish sprayed tin or lead coatings by scratch brushing, or by sealing them with a suitable medium for their particular conditions of service. Chlorinated rubber and various types of varnish have been successfully used for this purpose with or without the wire brushing. Tin spraying is largely confined to the food industries, while lead is used to withstand certain acids and for X-ray equipment and similar applications. While these cathodic coatings do give excellent results when properly applied and for specific purposes, yet they are only a mechanical protection and, if damaged, will rapidly break down, whereas in the case of zinc and aluminium coatings the extra protection afforded, by sacrificing some of the coating, is in practice more reliable. An example of a cathodic coating for a special purpose is the copper coating of coreboxes. These are metallised with copper to a thickness of 0.005 in. and used in the "as-sprayed" condition. It is found that the copper surface produces smoother, better cores with less vibrating time, and that a cleaner breakaway is obtained irrespective of the kind of core oil used.

The use of metal spraying for coating iron and steel can mean that with one small hand tool an ironfounder can provide his own finishes. This not only eliminates the necessity for relying on galvanisers, tinsmiths, and lead burners, but also permits him to use aluminium for those purposes where it may be advantageously em-

*Presented at the London Conference of the Institute of British Foundrymen.

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ployed, and this is something that no other commercial process can offer him. He may also at some time be called upon to apply a particular metal or alloy coating for decorative purposes, and here again he can select from the previously mentioned metals or stainless steel, nickel, Monel metal, copper, brass or bronze. Providing he has applied a sufficient thickness to ensure that the casting cannot be exposed to attack, he will have produced a finished article which, from appearance and corrosion angles, should be comparable with one cast entirely in the coating metal. In general, however, anodic coatings require to be so thick that such applications are often limited by economic considerations.

Metallised Patterns

Metal spraying is not confined to coating on to metal surfaces; wood, plaster, paper and a wide variety of other materials may readily be metallised. An interesting example of this, at least to the founder who has his own pattern shop, is the application of metal coatings to wooden patterns. It is not suggested that all wood patterns should be metallised, but it is definitely found that certain intricate patterns used on repetition work are well worth metallising. The added strength and the elimination of warping are obvious advantages, while the reduction of the risk of damage in handling is considerable. Thus a metallised wooden pattern which is relatively cheap to produce has similar attributes to a metal pattern, and yet it is much lighter and can be more readily modified if required. This last advantage, while not perhaps being normally very pronounced, was very noticeable in certain instances during the war, when rapid developments necessitated changes in patterns. It was found then that a little more metal could be sprayed on in one place or a piece sawn off another and then metallised. Without envisaging very substantial changes to the design of a pattern, it will be clear that the ability to stiffen up a web, to strengthen a fillet radius, or add to the thickness of another part, is extremely convenient, and metallising guns have been much used for this class of work not only on metallised wooden patterns, but also on metal patterns.

Coating to Resist Heat Oxidisation

Cast iron is employed under many circumstances where it is subject to heat oxidisation, as, for instance, in the manufacture of case-hardening boxes, heat-treatment pots, and furnace parts. Failure of such parts is in many cases due to heat oxidisation, and this can be reduced very considerably by the application of the appropriate metallising process. High purity aluminium is commonly employed for this purpose and is either put into service as sprayed or separately heat-treated so as to produce an iron aluminium alloy layer which itself is extremely resistant to heat corrosion.

Two other heat-resisting coatings are made possible by the metallising process, one involving the application of a nickel-chrome coating and another similar one involving the use of a double coating made up of aluminium superimposed on a nickel-chrome coating. These processes are the subject of British patents. They extend the usefulness of metallising to much higher temperatures than were hitherto thought possible.

An example of a special use of metal spraying in foundry work is the coating of an insert with the same metal into which it has to be cast. Thus, bronze studs required in an aluminium casting are first coated with aluminium on the part around which the metal has to be cast. It is found that this obviates certain of the disadvantages associated with casting certain metals around dissimilar metallic inserts, and in particular reduces the incidence of blowholes forming around the area of contact.

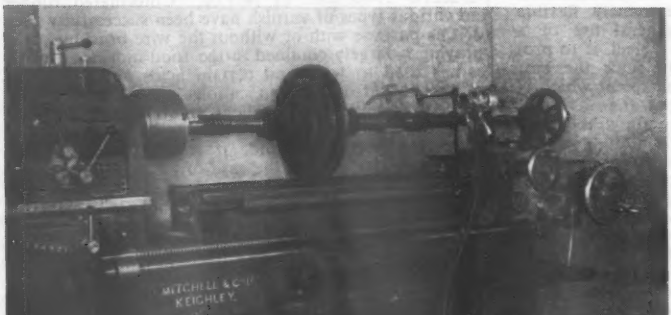


FIG. 1.—SET-UP FOR METALLISING USING A LATHE.

Production uses of metallising are many and varied—one application that has recently been devised is a method of finishing flat-iron bases. These are sometimes plated, but must be ground sufficiently to remove any imperfections before plating, not only for appearance, but because porosity or pinholes often retain the pickling acid—which can destroy the finish at a later stage. One concern now metallises the flat base of grey iron with copper to a thickness of about 25/1,000 in., it being found that this takes care of such imperfections and much reduces the time taken for the rough and finishing disc grinding. Using $\frac{1}{8}$-in. copper wire, one operator using a Type Y metalliser can easily metallise 100 such flat irons per hour, and the resulting job—apart from economies and

other advantages of not having to remove so much metal—is both attractive in appearance and the more efficient in heat transfer by reason of the heavy copper coating.

Salvaging Defective Castings

Porous castings which should be pressure tight can often be reclaimed by metallising either internally or externally. While zinc is often used for this purpose, in many cases it is possible to seal the casting by using a metal of the same specification as the casting. This class of reclamation work leads naturally to the salvaging of castings defective by reason of blowholes. While it is not claimed that a metallised filling in a blowhole will substantially strengthen a casting, there are many instances in which the defect is one of appearance only, and in such cases metal spraying offers not only the easiest method of repair, but one in which the metals can be so matched as to completely take care of any disfigurement. Various techniques involved in the repair of blowholes are dealt with in the latter stages of this Paper in which operation procedures are outlined.

Another salvaging operation which can prove of considerable saving to a foundry is the reclamation of undersize parts as, for instance, in a batch of castings where insufficient machining allowance has been made, or where for some other reason it has been found that a casting will not quite clean up. There have been many instances of valuable batches of castings being saved by metallising the defective part so as to give the required dimensions. Similarly, castings which have been machined in error can often be metallised, and frequently this can prevent waste of the considerable machining time already expended on such parts.

The reclamation of engineering components generally, particularly worn parts, may not be of interest to some founders, but there are many instances in which equipment can be shared between the foundry and machine shop, so that foundry departments of the larger firms should be acquainted with the possibility of using the equipment installed in other departments of the firm.

Fig. 1 shows a typical metallising set-up, using a lathe. The particular item is a turbo-extractor pump-shaft from a warship's auxiliary machinery, in which stainless steel is being deposited on the worn areas of the carbon packing glands. It has already been noted that metal spraying consists of melting a metal or alloy and depositing it by means of an air blast.

Types of Gun

The types of equipment used vary according to the form in which the raw material is supplied to the gun. Thus, the equipment may be classified as wire, powder, and molten-metal types. Of these, the wire type is the one most commonly employed throughout the world, and any data given are with respect to types of wire gun, of which there are several. Both the powder and molten-metal types have limited uses, mainly in connection with the lower melting-point metals, and are, therefore, not of such general interest.

How the Gun Works

The gun may conveniently be considered in two parts: (1) the mechanical feeding device, and (2) the combustion head. To feed a coil of wire at a uniform speed irrespective of kinks and other deformations calls for considerable power and precise control. An air-turbine is the source of power, and the most modern equipment incorporates an automatic governor to regulate the uniformity of the turbine speed, which may be as much as 60,000 r.p.m. The feed rate of the wire is only a few feet per minute (varying according to the metal being sprayed) and a double worm-reduction gearing is employed to give the requisite speed to a pair of knurled rollers which grip and feed the wire to the combustion head. The nozzle, through the central hole of which the wire passes, has a number of smaller holes to carry a mixture of the combustible gas and oxygen, which produce many small jets of flame to play upon the wire and melt it.

The compressed air, in addition to supplying power to the tool, has two further functions to fulfil. It atomises the molten metal and projects it on to the job. The particles, initially at or near the melting temperature, remain fairly hot, but as they are small and are surrounded by a large volume of cooler air, the mean temperature is quite low—so low, indeed, that it is possible to spray even steel or nickel on to the bare hand without discomfort. The result is that with most classes of work the job itself does not get hot, so that metallising has a distinct advantage over welding in this respect. The particles, which are spherical in flight, flatten on impact and, according to the hardness and rigidity of the base, the class of material being sprayed, and the distance of the gun from the work, take on a shape varying from saucer shape to spheroids.

Types of Wire Gun

There are general-purpose guns, of which the sectioned models (Type 2E), Fig. 2, is representative—and these are capable of depositing practically all metals and alloys in wire form. The commoner metals used are aluminium, brass, various bronzes, copper, lead, Monel metal, nickel, low- and high-carbon steels, 18/8 stainless steel, high-carbon high-chrome stainless steel, nickel-chromium alloy, tin and zinc. Additionally, Babbit metal, cadmium, and even silver and gold, are sometimes applied by metallising. There are also special-purpose guns as, for instance, those capable of spraying only low melting-point metals or, alternatively, those specifically designed for the higher melting point metals. Another type of special-purpose equipment

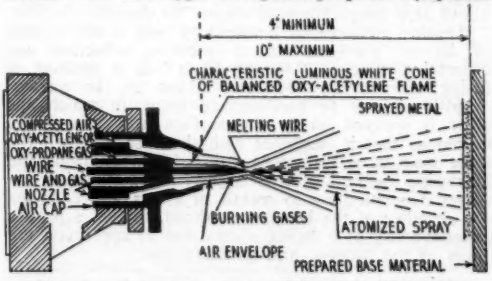


FIG. 2.—GENERAL-PURPOSE WIRE GUN, TYPE 2E.

E

Metallising in Foundry Practice

is known as the Type Y machine,* and is the fastest metallising tool yet devised. It can, however, only be operated in a machine, being too heavy for continuous hand-use.

Methods of Preparation

Since the bonding operation is the most important part of the technique, the various methods of preparation must be considered in relation to the resulting bonds. Except for certain cases in which heating is resorted to, or where coatings are held in place by contraction, metallised coatings are nearly always mechanically bonded to the base material. For a cold surface to be suitable to receive a metallised coating it must be clean, dry and rough. The term clean is used in the sense of its being free from oil, grease, oxides, etc., and by dry is meant absolutely free from moisture. It is the "rough" that calls for better definition, and the degree of roughness is less important than the kind of roughness. In general it must be a roughness that provides some dovetailing or keying effect.

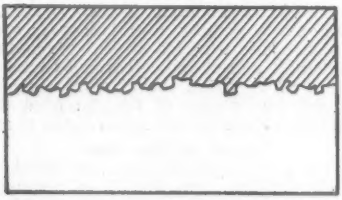


FIG. 3.—DIAGRAMMATIC REPRESENTATION OF A SHOT-BLASTED SURFACE.

Fig. 3 illustrates this and shows diagrammatically a section through a sand or shot-blasted surface. Some materials do not need any special preparation, provided that they are clean and dry; for instance, wood, textiles, paper, plaster, concrete and many forms of hardboard, etc., often do not call for any preliminary treatment, their surfaces provide a natural key. Another form of bonding already referred to is the heat treatment of metallised aluminium on steel, with which it alloys at a temperature of about 750 deg. C.

Another example of bonding by heat is the coating of heated glass—so as to produce reflective and decorative effects. "Spraywelding" is a method of fusing a metal-sprayed alloy layer on to various metallic objects to hard-surface them, in which the alloy is sprayed on to the surface and then flame heated so that it combines with the base in much the same way as a surface is "tinned" when using the blow-pipe method. Most engineering metallising involves deposition on to metals or alloys and calls for one or other of the bonding methods, so that a proper understanding of bonding allows one to appreciate the limits of the process, and its usefulness.

*Exhibited at the Conference.

(1) *Sand- or shot-blasting* is an obvious choice on the score of cheapness and speed. It is now known that blasting, even using a sharp, angular medium, pre-stresses a surface so as to improve its resistance to fatigue. Angular steel-grit, which is crushed chilled-steel shot, is the commonest abrasive employed. It is,

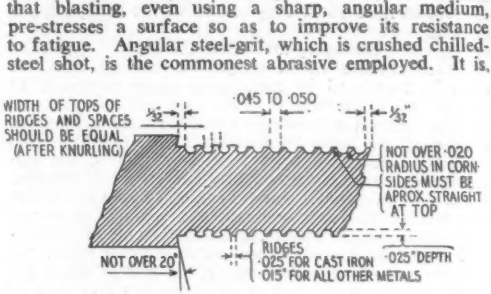

WIDTH OF TOPS OF RIDGES AND SPACES SHOULD BE EQUAL (AFTER KNURLING)
1/32"
·045 TO ·050
1/32"
NOT OVER ·020 RADIUS IN CORN
SIDES MUST BE APROX. STRAIGHT AT TOP
NOT OVER 20°
RIDGES
·025" FOR CAST IRON
·015" FOR ALL OTHER METALS
·025" DEPTH

FIG. 4.—SECTION THROUGH A SPREAD AND DISTORTED THREAD SUITABLE FOR RECEIVING METALLISED COATING.

however, quite useless on extremely hard steel, as for instance, on steel that has been treated by the induction hardening process. Fortunately, however, there are a great many engineering materials, including most crankshaft steels, which respond to it. Certain alumina and carbides are sometimes used to prepare hard steel. Sandblasting, using sharp flint grit, provides a good anchorage for thin coatings, but due to the health hazards (silicosis) it is almost exclusively restricted to outdoor work, such as the preparation of bridges and similar structural steelwork or work on ship's hulls.

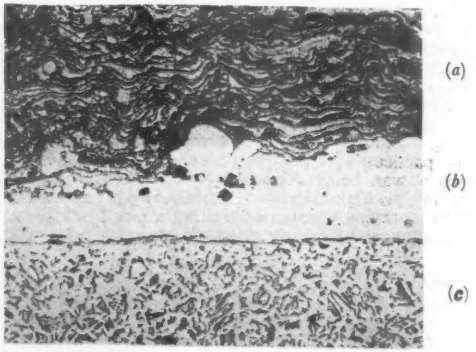


FIG. 5.—FUSE-BONDING: (*a*) METALLISED STEEL; (*b*) FUSE-BOND LAYER, AND (*c*) STEEL BASE.

For many years blasting was the only method of preparation employed. To extend the use of metallising beyond the normal coating metals of zinc, lead, tin and aluminium, so as to reclaim worn parts with steel, nickel, and other high melting point metals, other methods were tried. Shotblasting involves the human

element, calling for close-control of the materials, which deteriorate in use, and rigid observance of rules governing operating conditions. Unless it be known that the operator has followed certain rules it is difficult to assess the value of a blasted surface by visual inspection, so that it is unreliable for engineering work. On the other hand, the method is extremely suitable for preparing large surfaces to receive a thin protective coating, as for example, zinc on steel.

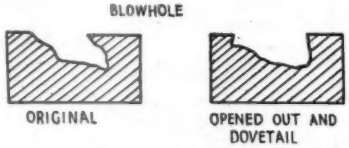


FIG. 6.—BLOWHOLE AND ITS PREPARATION FOR METALLISING.

(2) *Rough Threading* by cutting a screw-thread of 16 to 24 t.p.i. with a sharp-pointed tool, it is found that the tearing effect—especially if little rake or clearance be given—is adequate to produce excellent bonding on mild steel, and to a lesser extent on other materials. The "tearing" effect was easily procured with low carbon steels, was difficult with many non-ferrous metals, and almost impossible with cast iron. Good tearing forms an excellent key—but the risk of failure by fatigue seemed high, and although it sounds

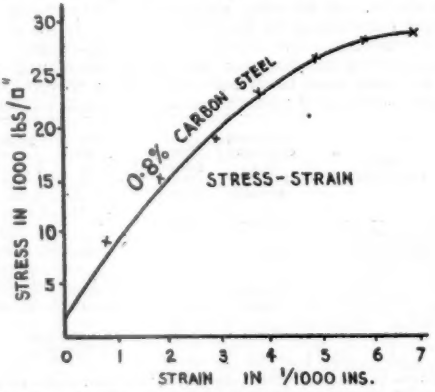


FIG. 7.—STRESS-STRAIN CURVE FOR A HIGH-CARBON STEEL.

easy to cut a rough thread in practise it was found that quite a high proportion of operators were unable to produce consistent results.

(3) *Grooving and Spreading* known as the "Metco" shaft preparation method, was invented in America just prior to the war. It involves only a simple machining technique and obviates many of the risks of earlier techniques, thus making it possible to produce repeatedly the same kind of surface and so obtain consistent results.

Fig. 4 shows diagrammatically the kind of thread that is cut and how it is distorted and spread by a special tool very similar to a knurling tool so as to give a dovetail effect. The method cannot, of course, be applied to very hard steels, so that the wartime invention of the patented "fuse-bonding" process (Fig. 5) provided a welcome further addition to metallising technique.

(4) *Fuse-bonding Process.*—An A.C. transformer is used—input 220 volts 14 amp. and output 9 volts maximum with a secondary current of 340 amps. Six air-cooled electrodes are used to stroke the surface to be prepared, and the effect is to produce a foamy surface, the formation of which has been described as being like frozen soap-suds. In fact, the charac-

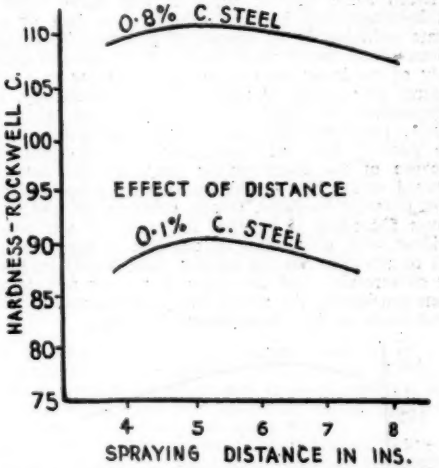


FIG. 8.—EFFECT OF DISTANCE ON HARDNESS OF DEPOSITED METAL.

teristic shape of the fuse-bond crater is very like a burst bubble, and the keying effect is extremely good—far superior to blasting. Its main advantage is that it can be applied even to the hardest steel, so that parts which were previously too hard to be prepared for metallising were brought within the field of application.

(5) *Spraywelding*, being a fusion process, cannot be compared with the foregoing, since it is more allied to welding than metal-spraying when the operation is completed.

(6) *Sprabonding* is a new invention, and while it provides an extremely good bond and requires no roughening or heating, comparative figures as to bond strength are not yet available.

Metallising in Foundry Practice

Physical Properties

Sprayed metal is unique in its structure, and in many ways falls between the cast and extruded or wrought states as far as its properties are concerned. It has been noted that sprayed metal is made up of small flattened particles and these overlap something after the manner of fish-scales but irregularly. In general the edges are torn, as would be expected following impact of a somewhat oxidised sphere, the outer surface of which had been cooled by the surrounding air. It is not known precisely what values attach to the factors making for adhesion between the particles, but they include mechanical interlocking of the particles by reason of their ragged edges and a tendency to flow so as to conform to the shape of surrounding particles, a certain amount of rather haphazard fusion-welding between some of the particles, and some form of oxide-cementation between others. The fact of adequate adhesion is, of course, of practical importance, whereas any theory as to how it is achieved is largely only of academic interest except in so far as quality control of coatings is concerned. Commercially, any improvement of coatings can only be envisaged for special purposes, since the adequacy of adhesion for the general field of metallising is well-established. Because of the characteristic shape of the particles, sprayed metal has varying machining properties and gives different hardness, tensile, compression and shear values according to whether the plane of test be coincident with, or normal to, the line of spray, and it will be obvious that the former value would be taken for compression and the latter for shear and tensile when considering the ability of sprayed metal to withstand loads as, say, in a journal bearing.

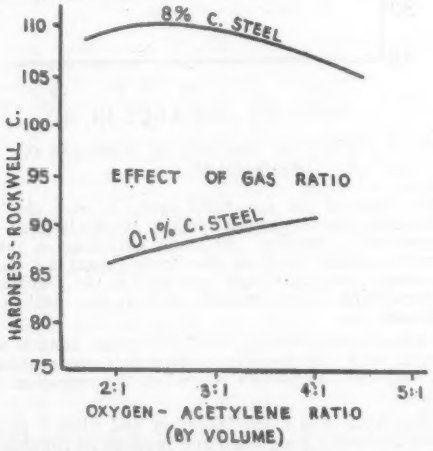


FIG. 9.—EFFECT OF OXYGEN-ACETYLENE RATIO ON HARDNESS.

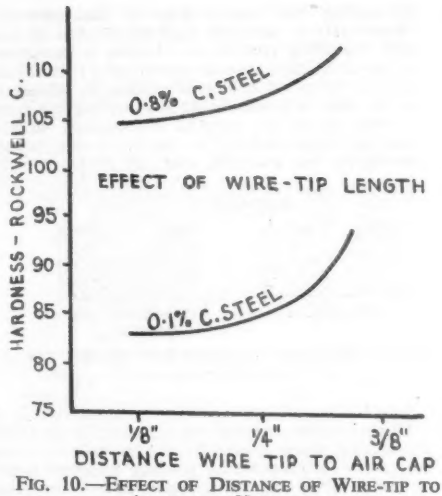


FIG. 10.—EFFECT OF DISTANCE OF WIRE-TIP TO AIR-CAP ON HARDNESS.

With some classes of work less attention need be paid to the degree of bonding than to the proper shape of the receiving surfaces, and blowholes often fall within this category. Generally, the main precautions with blowholes, are to make certain that all parts of the cavity requiring to be filled are accessible to the spray, and secondly, that unless either Fuse-bonding or Sprabonding preparations are to be employed, the outer edges must be of such a shape as to provide a dovetail. Fig. 6 illustrates this clearly, and many blowholes are metallised successfully with no other preparation than opening out and dovetailing as indicated, and no precautions other than the masking of the remainder of the work to ensure that no metal is sprayed on to the unprepared surrounding surface. Fig. 7 shows a typical stress-strain curve for a high-carbon steel.

TABLE I.—*Influence of Surface Treatment on Mechanical Properties.*

Surface preparation.	Estimated endurance limit, 2 × 10⁷ cycles.	Stress concentration factor.	Axial shear 2-in. cylinder band 0.2 in. wide.	Rotary shear 1 in. dia. × 2 in. × ¼ in. × 0.2 in. hex.
A. Shot blasted ..	54,000	0.76	1,200	3,150
B. Rough threaded ..	30,000	1.37	7,090	14,700
C. Grooved and knurled	27,000	1.52	6,000	25,400
D. Fuse-bonded ..	35,000	1.17	9,000	24,100
C and A combined ..	37,000	1.11	7,000	25,000
E. Plain polished spec.	41,000	1.00	This specimen was not sprayed.	

Sprayed 13 per cent. chrome steel on 3½ per cent. nickel base.

Figs. 8, 9 and 10 indicate how operating conditions can affect the hardness of the deposited metal.

(To be continued.)

"Sandstorm Secrets"

Discussion centres on Core-box Joints, Vents, Drying Shells, and Costs

Following the Presidential Address at the opening meeting of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, Mr. Blakeborough's film "Sandstorm Secrets" was shown and discussed.

DISCUSSION

Opening the discussion, the Branch-President (Mr. John Hird) said the film was a classic and an example of the skill of another science, which had been harnessed to solve, or help to solve, foundry problems. One could look forward to the time when one might see a mould filled with molten metal in a like manner.

MR. DAVIS asked whether the Author had a deep groove vent on the corebox face or a long shallow vent of 0.002 in. or 0.003 in. depth.

MR. G. R. SHOTTON said it was rather evident from the behaviour of the sand in the mould that the isolated corner or pocket of sand did not need venting, when there was a vent perhaps near the pocket. He would like to know whether that was the principle on which they worked. It did emphasise something which was generally accepted and that was that the blowing head itself must be adequately vented in the majority of cases to ensure the adequate escape of air.

MR. L. CLARKE observed that an outstanding point that needed stressing was the fact that the vents affected the speed of filling-up in the right direction. All that went towards making clear the value of the film; the vents affected the direction of flow more than anything else.

MR. HIRD said that was true. Some people thought that if a vent was placed in a corner it would pull the sand to the vent. It was obvious that this was not so, the most likely thing to do that was to put some obstruction to direct the sand there.

MR. DAVIS said that as far as venting the nozzle was concerned, he had never found it that way. Much depended on the core and the method of blowing. Generally speaking, it is obvious that a vent must be there, but care must be taken as regards the size of the vent or a hole will be left in the core. A vent larger than 0.010 in. will leave a hole in the core; it tends to blow sand out of the box rather than fill it up.

Core-box Joints

MR. HIRD said the point of a vent drawing the sand and leaving a hole was very strongly emphasised down the joint line, when the box had a bad joint. Had anyone any ideas on this subject of box joints? Steel facing of aluminium boxes was expensive. Some people recommend the use of iron or steel boxes, but they were expensive to prepare and also very heavy to use.

MR. DAVIS said that if aluminium boxes were faced back and front, there should be no leakage at the joints when clamped. What was probably happening was that the operators were careless in the handling of the boxes on the stripping bench, causing uneven wear on the back face, so that when the clamp engaged on the worn face it had the effect of springing open the box joint instead of clamping it tightly.

MR. WEAVER said the suggestion of Mr. Davis as to the carelessness of the operators depended on the design of the corebox. The operator was blamed for the faulty cores, but the job had probably been insufficiently planned. There was more in the design of the coreboxes—far more than the film showed.

MR. A. J. SHORE, agreeing with Mr. Weaver, said that had the film been produced some years ago they would probably have been saved some of their problems. It was a little early for him to come to any conclusions, but, referring to the vertical type of blower, he felt that the central air-controlled plunger did not hold the box with sufficient tightness, because the internal pressure on the box was greater than the pressure on the plunger. He was experimenting with positive toggle clamps which could not push apart, but he was not yet able to say whether they would be successful.

Rubber Joints

A MEMBER remarked that on the question of box joints one would always get a certain amount of wear. There was one point which was an asset, and that was to lead the air, rather than let the air find its own way. There were various ways of doing this.

MR. HIRD said he presumed the member meant to take the pressure off the joints. He had always felt that the right joint would be a rubber joint. He had never seen it tried, but felt that it would be satisfactory, as when the box was squeezed together the rubber would squeeze into the box shape.

MR. WEAVER said he had tried rubber joints but they had presented difficulties such as creep, etc. One of the best joints was to machine a "V" groove on the face of the corebox; that sometimes gave a little bit of flash, but it did hold.

Compressed-air Clamps

MR. S. DAVIS said the main thing in core-blowing was to get the air away normally, so a rubber joint was detrimental to the easy flow of air from the joint. He used cams to clamp the coreboxes; he did not favour compressed-air clamps, the principle being that a certain amount of air will get through the corebox

"*Sandstorm Secrets*"

joint when it is clamped. In using compressed-air clamps the joint is sealed too tightly, leaving no clearance for the air. A good test is to place four pieces of paper 0.003 in. thick on the joint before clamping.

MR. HIRD said that he had found that in blowing out of the joint, the type of sand made a difference. Dry sand would blow out, leaving rat-holes down the joint of the core, but increased moisture content in the sand eliminated the trouble.

Cost of Core-blowing

A MEMBER said one thing so far not mentioned was the cost factor of core-blowing. There were many foundrymen who would not be able to answer if asked if they knew the cost, and it was only on huge production runs that core-blowing would pay. There were many things to consider besides wear and tear. All cores from core-blowers would collapse when removed from the box unless transferred to a shell carrier before going into the oven. Some organisations had hundreds of dryers, which had to be accurate, and there were many foundries that had discarded core-blowers because of their cost.

MR. HIRD said that even if the cores were accurate initially they had a habit of changing their shape, and it had been found that 50 per cent. of them had warped, and the cores did not result as intended. Cast-iron dryers were better in this respect than aluminium. One could not think of core-blowing without shells.

MR. TAYLOR said it seemed to him that in core-blowing one obtained a severe rush on the inner wall of the box against the point where the sand was hitting. Was there any way of avoiding wear at this point by using chilled iron inserts to help maintain accuracy. He could visualise a core-box being in work too long and producing cores that gave a thin section in the casting. This could happen where it was not easily disclosed by core inspection and one was then faced with a batch of scrap castings.

Size of Blowing Hole

MR. PRICE had found in his experience that if one regulated the size of the blowing hole, the velocity of the sand could be increased or decreased, and in that manner eliminate the wear of the corebox. He had made experiments with blowing holes of varying sizes, blown vertically, not horizontally, and found that a hole of $\frac{1}{32}$ in. dia. at 90 lb. pressure was good, and the wear over the past nine months had been negligible.

MR. HARRISON, reverting to the question of shell carriers, said there were two types of aluminium dryers and two schools of thought. His firm produced hundreds of shells, and, strangely enough, were asked for L33, and the reason for this is that they were easily re-shaped after being distorted. He also received requests for alloys similar to DTD298. Its supporters insisted that this alloy was not liable to distortion. He could not confirm this.

MR. S. DAVIS said that as far as general cost was concerned, he was making about 40,000 cores per day on multiple core-blowing and found a check taken after blowing 750,000 cores from one corebox showed the wear to be negligible, provided that the size and position of the blowing hole was regulated. Aluminium shells might distort or get bent by mishandling, and result in scrap, whereas a cast-iron shell mishandled would break, and consequently would not be used to produce distorted cores.

MR. H. G. HALL said there was one point in connection with costs and that must be stressed, that when you had equipped the core-blower one must have a gang to work it and use it efficiently. On the question of the number of shells required, he said that if one adopted standardisation of corebox sizes the number of shells did not arise, as frequent changes of corebox could be made on one machine setting.

MR. HIRD, referring to aluminium shells, said it was expansion which caused either cracking or distortion of the cores during stoving. There was another development, the synthetic resin-bonded type of core. That overcome some of the drying distortion and the drying time was shorter, so that one needed fewer shells. The distortion was not so great because the temperatures were lower.

Plastic Drying Shells

MR. GRAHAM, referring to plastic shell carriers, said he had spoken to foundrymen who claimed to have a suitable material which did not change shape up to 250 deg. C. Looking into the future, it was possible that a plastic shell might be necessary for di-electric drying. In America it was used and the plastic shell was under experiment. They were easily made. One did not need to have elaborate jigs and tools or dies for producing a shell as they could be made with precast resins. If one produced one aluminium box one could take the liquid resin and bake it in an ordinary oven at 140 deg. C. and get an easily produced article which was suitable dimensionally and would stand much handling. Plastics could be dropped without causing damage. The di-electric drying might seem to be a very ambitious method, as the apparatus was expensive, but it was possible to dry cores like the ones shown in the film for valves or similar types of castings. On a continuous plant it would cost £1,200 to £1,500 and would produce a ton and a half of cores per day. When the cores weighed a few ounces it was economical. The number of shells required was very small because the total drying time was not more than 2½ minutes.

American View of Corebox Venting

MR. J. W. DEWS, to bring the discussion back to the film, said it was a source of some gratification that British technicians had stolen a march on American propaganda. An American technician had made two observations in his theory on core-blowing, and the first one, the position of the vents, had been mentioned that night. His observation was that sand was blown into the corebox under pressure, and arrived

(*Continued on page* 536.)

The Institute of British Foundrymen — *London Branch Presidential Address*

Foundrymen and the Engineer

At the first regular meeting of the London Branch of the Institute of British Foundrymen for the present session, held on October 27, Mr. P. D. Pincott, the new Branch-President, occupied the chair, and opened the proceedings by extending a warm welcome to the President of the Institute, Mr. R. B. Templeton, a Past-President of the London Branch. He then delivered his address, in the course of which he said:—

From the very commencement of my association with the foundry industry I have been conscious of the great field of opportunity there is available to the methodical and explorative mind, and whatever the particular inclination or ability of that mind, whether towards practical moulding, or coremaking, or applied science, I am more than ever convinced to-day that there are virtually no limits to the extent that one's abilities and ingenuity can be applied to the development of the foundry and the improvement of one's individual position.

Scope of Technological Improvement

The past twenty or more years have resulted in great progress being made within our industry, and whilst one looks upon this progress and achievement in the collective sense, my own view is that the strides made have been mainly of a technological order, showing a great and useful contribution by the technical man in the foundry, and proving conclusively that scientific methods of control and development applied to the various foundry processes not only increase productivity of the foundry, but show also the value of giving technical aid in all its forms to the practical foundryman. The need for such measures cannot be denied, and the theme of this address is, give encouragement to a further participation in foundry matters by those people whose qualifications, either present or potential, are concerned with technology, and in this connection I stress in particular the engineer, whose mechanical outlook can do much in assisting the foundryman in the fulfilment of his task and, moreover, improve the environment of the foundry in all its senses.

The foundry and foundryman have long since arrived at the juncture when aid and consideration is warranted from the engineering mind, and on looking back I cannot help but feel that the engineer has neglected to give the foundry the requisite amount of his time and attention. There is indisputable evidence that the production of castings by the most elementary methods involves engineering principles, and I ask you all to consider the benefits to be derived from the extended activities of the engineer in the foundry and not necessarily confined to the completely mechanised foundries. The engineer is just as important an individual as the technical man or metallurgist, and I strongly recommend that both foundrymen and engineers who are not already teamed together should contemplate seriously such an alliance, as it is by this combination that so many of the questionable conditions which exist in foundries to-day can be improved and perhaps eliminated. It is necessary at all times to be fully aware that the foundry department is closely allied to the engineering industry, and as such requires much the same thought and treatment as any engineering department, and to attain this end there should be, on the part of the foundryman and the engineer alike, a mutual appreciation of each other's abilities and problems, because it is only by such understanding that the fullest aid may be directed to the foundry. Lack of such an understanding has resulted in so many foundries remaining in the primitive state characteristic of an age long past, and therefore no longer attractive to the young man seeking employment, or perhaps even tolerable to the older man who has suffered the conditions for so long.

Example of Automobile Foundries

The engineer, in close collaboration with the practical foundryman, can produce excellent results from the partnership. Take, for example, the automobile industry and the intimate attachment which exists there between foundrymen and engineers, and examine the foundries themselves engaged on this work. What fine models of a modern, productive industry they are. In those foundries the production of castings is materially aided in all stages of design and manufacture through the work of the foundry engineers, and every advantage is taken of engineering principles to give the foundries a congenial atmosphere and to remove most of the heavy manual operations which have so long been part of foundrywork. On entering a foundry of this type one can sense efficiency, and on leaving it later there neither remains in the mind the impression that it was dirty nor depressingly uninteresting. Plenty of healthy daylight and good artificial lighting; well-kept plant suitably protected outwardly by attractive paintwork; clearly defined gangways and concrete floors wherever possible, are essential. Whatever the class of work a foundry may be engaged upon, there is still a need for the laying of concrete floors, even if on a selective basis, whilst clean, light-reflecting walls and all these amenities in combination typify the modern foundry, approximating the standard of congeniality found in the machine shops. The type of foundry indicated does not create a sense of depression or lack of individual opportunity in anyone's mind, whether onlooker or worker, and provided that human relationship in such a foundry is of the right order, there should be little difficulty in the recruitment of labour.

It may be considered somewhat unfair to compare the repetition-production foundry with the general engineering and perhaps jobbing foundry in terms of plant in-

London Branch Presidential Address

stallations and the like, but there is not such a great disparity in the respective productive methods as at first imagined. Most foundries find it necessary, for some reason or other, to produce both jobbing and repetition work, and it is, after all, in the proprietor's interest to employ the best production methods for making his work, at all times having in the forefront of his mind that the experienced skilled craftsman is in very short supply and unlikely to reappear in substantial numbers for some time. In the absence of a sufficiency of skilled craftsmen, there is a greater need than ever for the increased use of mechanical aids, so that foundrymen and engineers alike must be resigned to the fact that their house will have to be put in order if the effective position of the foundry, as the supplier of basic components, is to be maintained.

Attributes of the Skilled Craftsman

It is perhaps difficult in these days to realise the amount of knowledge and experience the older skilled foundry craftsman had to possess, and also the amount of arduous manual effort and deep thinking that was necessary for the production of sound castings. Moreover, the knowledge with which the craftsman ultimately emerged was nearly all derived by trial and error; he had little by way of reference books applicable to his work with which to increase his knowledge. One must view with great admiration the courage and determination of this craftsman for the way in which he assailed and mastered his subject; he combined with considerable skill the rudiments of chemistry and engineering to the satisfactory conclusion of producing castings. It must be remembered that this craftsman was the man who, some years ago, was the very beginning and end of casting production, the man responsible for the foundry industry, the man who placed his love of the all-absorbing and fascinating process of making castings above and beyond the fact that his craft was hard and sometimes difficult to pursue. Just how much he preferred being the sole brains of casting production and left to his own resources is sometimes open to speculation, but there is no doubt that, as time passed, his work became more exacting and proved a greater mental strain than hitherto, and at this point I am convinced that the engineer failed him. He failed to understand the foundryman's problems and did not interest himself sufficiently in giving him assistance and encouragement.

It was not a wilful disregard of the foundry and foundrymen so much as an impression gained by cursory contact with foundrywork that it was by necessity a dirty process and one which needed, at the most, no more than the average amount of intelligence for the fulfilment of its various processes. How wrong that impression is I leave you to judge. I would emphasise, too, that there is still an impression current among a few engineers and other sections of the community which supports the picture I have presented to you, and until measures are taken to disperse that belief completely, there will be insufficient progress made in the improvement of foundry conditions generally, and efforts in the recruitment of fresh labour into the foundry will become stalemate.

Fascination of Foundrywork

Those like myself who entered the foundry by design and others by circumstance will perhaps recollect the impression they experienced following the crossing of the foundry threshold. It may not have been a good one—it seldom is to the layman, but all the same, they probably became conscious, after a time, of a fascinating grip which the work held for them; some indefinable spell which exerted its influence. Mainly it was, I think, at the elusiveness of the infinite number of factors connected with the work; but, call it what you may, in the patient endeavour or dogged determination to master some of the engrossing problems which continually beset the foundryman, there is at all times an invigorating sense of self-satisfaction and well-being, and especially is it so when one's efforts result in the achievement of some objective consistent with sound reasoning.

It is the duty of everyone associated with the foundry industry to transmit this enthusiasm for the work to others; to separate the process into its various parts and to prove that it is neither an elementary nor, conversely, a mystifying process, but an applied science following the laws of chemistry, physics and mechanics, combined with dexterity, and which offers opportunities in all its sections for young men seeking a trade or profession. For the more mature in the engineering industry it presents a field of exploration where, in conjunction with the foundryman, much can be achieved that will be of mutual value.

Specialised Attention to Engineering Problems

Although nowadays many foundrymen in an administrative position are equipped with a knowledge of engineering, I am of the opinion that the development of the maximum value of the principles in the foundry should be the sole duty of an individual unhampered by the more obvious matters of production. To give attention to such application of engineering as will benefit the foundry in every sense, I strongly urge the adoption of this course of specialisation wherever it can be applied. There is already to hand sufficiently convincing evidence of the advantages to be gained from such steps, and although the employment of an engineer may necessarily result in initial additional expenditure, it is a no less wise investment than was that of giving the laboratory technical man his responsibilities, since he has proved an essential member of the foundry and a valuable colleague of the foundryman. Let the engineer have an unrestricted freedom of expression and thought at the commencement of his duties so that he will not be influenced by past methods and habits in the foundry, and I think if the selection of the individual has been reasonably sound there will be a surprising amount of profit arising from his observations and suggestions. Thereafter it is, of course, imperative that he should work in close collaboration with the foundry manager.

Fields Open for Attention

There are innumerable subjects in the foundry which can benefit by unrestricted meditation such as should be

possible to the engineer, and whilst I will not inflict on you a comprehensive list of examples, I will dwell on one or two of the more fundamental issues. First, as regards the lay-out of the foundry and its relationship to the material-flow lines, with the vast amount of transportation of material and tackle in the foundry, it is very easy to waste effort and production by the random installation of plant, and often a time and motion study on sections of the lay-out will reveal a means of improving efficiency by a prudent re-grouping of sections of that plant. There are known to us many examples of indifferently well laid out foundries occasioned by extensions to the original building, and while the wisest and most obvious course is to ponder carefully before installing any plant at all, it is never too late to correct an error which has subsequently become apparent. The second subject recommended for interest to the foundry engineer is the choice and selection of plant. The foundry is notorious for its disastrous effect on machinery of any type which is not properly designed for use in abrasive conditions, nor otherwise suited to the requirements peculiar to heavy work. Although the manufacturers of the appropriate plant no doubt endeavour to provide for certain extreme conditions, there is sometimes, particularly in these days, a restricted choice of plant, and it is quite possible because of this to spend money unwisely and thus to suffer setbacks in foundry production.

My final remarks I should like to address to the manufacturers and suppliers of foundry plant generally. I have taken from almost the commencement of my entry into the foundry, keen and varied interest in types of machinery provided there. With rather more than a passing knowledge of some of this plant, I have reluctantly come to the conclusion that there has been a relatively small contribution by way of British design to the many types of machines installed in our foundries. It is all very well to be complimentary to the foundry plant designers of other countries by building similar machines here, but let there at least be a justification in foundry machinery of the opinion of the world which praises our engineering prowess, and, as a means to this end, may foundry engineers take a far deeper interest in development and make themselves responsible for a greater proportion of the brainwork in the plant itself, the design of which is acknowledged to be symbolic of progress in the foundry industry.

Vote of Thanks

MR. V. C. FAULKNER (Past-President of the Institute and of the Branch), proposing the hearty thanks of the meeting be accorded the President for his address, said the subject of the utilisation of the services of the engineer to the best extent was one of interest to all. One asked oneself why in the past the foundryman had not been assured of that help; one could only think that in medieval days the foundry was closely connected with the monastery, for which the foundry had to produce a large amount of artistic work. As all foundrymen were artists, and as all artists were temperamental, the foundryman had always been temperamental. Such men were difficult to get on with; probably when the engineer approached the foundryman they did not find that their temperaments were in accord. The industry had thus suffered by lack of co-operation between the two professions, and he complimented the Branch President on having made a very wise appeal for the more widespread recognition of the obvious services which the engineer could give. It was the logical solution to the major portion of the industry's difficulties.

The vote of thanks was seconded by MR. FRANK HUDSON and was carried with acclamation.

Olivine as a Foundry Refractory

An article received from the Norwegian Export Council details the mineralogical composition of olivine (chiefly magnesium ortho silicate, $Mg_2.SiO_4$) and forsterite, their occurrence in nature, and the chief deposits throughout the world. The melting point is given as 1,700 deg. C. Stress is laid upon the impossibility of contracting silicosis from its use. We have extracted the following as being of major interest to our readers.

Olivine of the best quality is substantially more refractory than quartz, and also shows greater resistance to scorification of iron oxides. Its use, therefore, prevents the incrustation of sand and scoriæ on the surface of the castings. By the proper use of olivine a particularly clean surface is obtained. The high resistance of olivine to pulverisation and scorification makes it possible to use it longer than quartz sand.

While in transit, storage and use, olivine sand must be protected against injurious contamination likely to detract from its phophylactic and technical properties. Impurities caused by contamination with quartz, feldspar, lime, limestone, and with clay (which lowers the melting point) should be particularly guarded against. Thanks to the provisions of the Norwegian Olivine Act of March 1, 1946, every buyer and consumer of Norwegian olivine—both at home and abroad—has the assurance of being offered only high-quality products. Since the war olivine sand has to a large and increasing extent replaced quartz sand in Norwegian steelfoundries. These foundries will soon make exclusive use of olivine. It is also anticipated that quartz will be replaced by olivine in the ironfoundries.

Norway is now in a position to deliver the following olivine products—(1) Moulding sand for steelfoundries and for heavier machine castings of iron; (2) moulding sand for mass-produced castings and for smaller machine parts cast in green sand; (3) core sand for iron and steel foundries; (4) dusting powder, etc., and (5) moulding sand for iron and steel founding, and various olivine products for metal foundries. Deliveries can also be made of such products as lining materials for cupola furnaces and for electro-furnaces for iron and steel smelting.

MISS LILLIAN K. POLZIN, honorary secretary and treasurer of the Twin City Chapter of the American Foundrymen's Society, has changed her address to 1750, Hennepin Avenue at Grovelind Terrace, Minneapolis 5, Minnesota.

Fatigue Strength of Cast Crankshafts

The third Annual Report of the Motor Industry Research Association outlines, in what follows, the work being done in this field.

Work on bending fatigue strength was started first, because suitable testing machines were available. During the year, a report has been issued on the effect of proportions and size on the bending fatigue strength of single-throw shafts of conventional design made from the same cast iron. The effects of surface finish, radius and shape of the fillet, breadth and thickness of the web, length of crankpin, size of lightening holes, and overlap of main journal and fillet have been investigated on cast shafts of 4½-in. main-journal diameter. Tests on one geometrically similar design scaled down to half this size have shown a considerable scale effect, the smaller shafts being between 25 and 30 per cent. stronger; part of this increase may be due to the effect of mass on the properties of the cast materials. Although, unlike steel, cast iron is insensitive to surface finish, it has been shown to be just as sensitive to general changes of shape, and it is considered that most of the conclusions reached on the effect of design are equally applicable to forged-steel shafts.

Sufficient tests have been carried out on one design to give useful information on the variability of the material in respect of fatigue strength.

Further tests on cast crankshafts of various special designs, having a main journal diameter of 2½ in., have shown that the design of the cored lightening holes in particular has a marked effect on bending fatigue strength. Other features of design are also being examined. The importance of such special designs lies in the fact that, although for the same design cast-iron shafts are essentially weaker in fatigue than forged-steel shafts, complicated designs which would be impossible to forge can be produced by casting at little extra cost.

Methods of Testing

To assist in the development of the best design as well as to help in explaining unexpected fatigue test results, two methods of measurement of local stresses are being used. Wire resistance strain gauges of ¼-in. gauge length are useful in indicating changes in stress distribution brought about by changes in design, although they only measure the average strain over the area covered by their wires. For measuring highly localised peak stresses, a photoelectric extensometer of gauge length $\frac{1}{16}$ in. is used. As a preliminary to both methods of measurement, brittle lacquer or resin has been used to indicate the directions of principal strains on the surface.

A conventional design of 4½-in. crankshaft has been chosen for comparison of about a dozen different cast materials, about half of which have so far been tested. Various mechanical tests are being made on specimens cut both from the crankshaft castings and from separately-cast test-bars, to determine whether the suitability of a cast material for crankshaft use can be judged from any of the usual mechanical properties. Castings are also being prepared for examining the effect of surface treatments, such as shot-peening, on the bending fatigue strength of cast crankshafts.

A torsional fatigue testing machine for single-throw 2½-in. cast crankshafts, has been designed and is under construction. In principle, it consists of a freely-suspended two-mass system in which the crankshaft, bolted between two steel extension shafts, forms the flexible element. Various methods of exciting the system and controlling the torque are being investigated.

(*Concluded at foot of col. 2.*)

"Sandstorm Secrets"

(*Continued from page 532.*)

through the nozzle into a cavity, inside which the pressure was lower, due to expansion. The sand was being carried in suspension in the blown air and, due to the sudden expansion and drop in pressure, the sand was deposited. According to that theory the sand came to rest immediately beneath the inlet of the nozzle. That is why is was postulated in America that vents should be placed at the far end of the corebox away from the nozzle, for, as the core filled up from the nozzle end, the cavity got smaller, and the vents should be at the other end to allow escape of the air. He (Mr. Dews) thought the film had shown on the evidence produced visually that our American friend was wrong. If the vents were put on the other side the sand came in and partially blocked them so that the speed and rate of flow were reduced to a considerable extent and this would prevent the box from filling completely.

MR. A. TIPPER asked whether anyone had any ideas on the "Sand-on-Tap" system of carrying the sand in air; he wondered whether it was used in this country.

MR. ROWE replied that the "Sand-on-Tap" method was under review; certain developments were taking place and something would be done on this in the near future.

MR. HIRD proposed a vote of thanks to Mr. Blakeborough for the loan of the film, which was carried with acclamation.

Publication Received

Cast Iron Rainwater Goods. Published by the British Standards Institution, 24/28, Victoria Street, London, S.D.1. Price 5s. net, post free.

This publication covers B.S. 460 and 1,205:1948, and is particularly comprehensive. The reviewer knows no more successful essay of standardisation than the one covering this field, as but a few decades ago the number of patterns to be carried was enormous, and tended to grow. Now the situation has been tidied-up, with resulting benefits to the manufacturer and user alike. Even now it requires a 54-page booklet to set out all the details. Clarity in both the sketches and the letterpress alike is commendable.

Iron Castings Freed from Control

Standardisation of Engineering Products : Steel Distribution Scheme Amended

The setting up of a committee to investigate the standardisation of engineering products, new distribution arrangements for smaller consumers of steel, and the removal of iron castings from distribution control were announced by Mr. G. R. Strauss, Minister of Supply, last week.

STANDARDISATION COMMITTEE

Asked in the House of Commons on November 22 whether he could make a statement on arrangements for encouraging standardisation in the engineering industry, Mr. Strauss said that he realised that there were limits to the extent to which this process should be carried, but he was convinced—as were his Government colleagues responsible for industries which use engineering products—that reduction in variety of engineering products and components could with advantage be taken very much further. He believed this would bring about increases in productivity and a saving in spares and stocks and would effect very considerable other economies of substantial and lasting benefit to the country.

The matter, said Mr. Strauss, needed expert investigation and he had therefore decided to appoint a Committee drawn from industry to advise him. The Committee, as well as consulting with the British Standards Institution, which had promised its support, would consult with the makers of the products which came under review and with the users whose demands for special types of goods set the pace for the makers.

The Minister added that he was anxious that the Committee's tasks would not duplicate those of the Committee of the Anglo-American Council on Productivity set up to examine the development of specialisation in the production of parts and components in the U.S. and to see to what extent it is applicable in this country. He had accordingly consulted with the British Section of the Anglo-American Council to ensure there was no overlap and that the two Committees kept in touch.

The Committee will report directly to the Minister. Its members have been appointed, not as representatives of particular sections of the industry, but for their personal qualities and abilities, and for the respect and confidence they command throughout the engineering profession. The members are:—

CHAIRMAN: Sir Ernest Lemon, former vice-president (operating and commercial) of the L.M.S. Railway Company; Director-General of Aircraft Production. Air Ministry, 1938-40; special adviser to Ministry of Production, 1942-45.

DEPUTY CHAIRMAN: Sir (Frank) Ewart Smith, a director of Imperial Chemical Industries, Limited; former chief engineer of I.C.S. Billingham factory: Chief Superintendent of Armament Design, Ministry of Supply, 1942-45.

MEMBERS: Mr. Stanley Harley, deputy chairman, Coventry Gauge & Tool Company, Limited; Mr. Jack Tanner, president of the Amalgamated Engineering Union; Mr. T. H. Windibank, a director, Crompton Parkinson, Limited. The secretary will be Mr. E. G. Cass, Engineering Industries Division, Ministry of Supply.

Terms of Reference

The Committee's terms of reference are:—"To investigate in consultation with the British Standards Institution and appropriate organisations the methods by which manufacturers and users of engineering products determine whether any reduction in the variety of products manufactured is desirable in the light of technical, commercial and other considerations; to report whether these methods are adequate and what, if any, further measures should be taken by industry or by the Government to ensure that such simplifications as are determined are put into effect."

Methods of standardisation recommended by the Committee and adopted by the industry will not, of course, be allowed in any way to hamper research work. Research and development will continue to be unfettered by any factors tending to limit their scope. No standardisation plans will be pursued if they show any likelihood of upsetting or interfering with the overseas demand for British engineering products. Briefly, the Committee's task is to find out and recommend means of standardisation which will benefit the industry without hampering any of its vital activities.

It is fully recognised that there are certain industrial fields in which further simplification, for one reason or another, is unworkable. For instance, in the case of capital equipment, attention has to be paid to labour, space and material needed during the equipment's use as well as in its construction, and this may well decrease the margin in which standardisation can be wisely imposed. Research and the special needs of the export market, as already noted, may also limit the scope of standardisation, which will only be introduced where it is really going to be useful.

The Minister of Supply has discussed with his Engineering Advisory Committee (made up of employers and trade-union members) the proposal to set up the Standardisation Committee, and received from it a promise of full support.

STEEL DISTRIBUTION SCHEME

Details of a new steel distribution scheme for smaller consumers were outlined by the Minister of Supply in London last week. He said it would simplify the procedure by which smaller firms were authorised to get steel supplies. It would cut out a mass of paper work. It should free people engaged in such tasks for more important activity. In general, it would remove a number of the worries which at present afflicted small consumers.

The scheme would apply to nearly all firms who used (and sub-authorised) less than 25 tons of steel in each quarter, and whose total consumption of steel

(including sub-authorisation) did not include more than 10 tons of steel sheets. Steel allotted to such firms must be for "industrial purposes," *i.e.*, for use in manufacture or for further processing; for use in industries such as mining and quarrying; or for the maintenance and repair of plant. The scheme did not cover the use of steel for building or the repair of buildings, and supplies to builders and civil engineers would continue to be the responsibility of the Ministry of Works. Some firms, under the present system, needed scores of authorisations every quarter; now they would need only one, which would be issued by the Ministry of Supply Regional Office for their own area, and would last for a year.

The new arrangements would not apply to tinplate, terneplate or black-plate steel. In those cases the present system would remain in force. All firms in Northern Ireland were excluded, but would probably be included from April 1, 1949. Other consumers excluded were:—Oil companies; builders; constructional and civil engineers; electrical contractors, and firms engaged in the production of iron and steel products under licence issued by or on behalf of the Iron and Steel Board.

IRON CASTINGS CONTROL

Mr. Strauss also referred to the removal of iron castings from distribution control. He said that they would no longer be subject to control under the Iron and Steel Distribution Scheme, and no further I.S. authorisations would be needed for their distribution. The relaxation did not mean that the supply of iron castings was now unlimited, or even ample, but their supply position was certainly better than that of steel.

The relaxation of control was due to two factors. First, a scheme of voluntary control had been accepted for the specialised items which made up the most vital part of the industry. Secondly, the remainder of iron casting production, which was mainly handled by jobbing foundries serving local needs, was not an appropriate field for formal central control. The pig-iron and scrap needed in the production of iron castings would continue to be controlled, while the export of castings as such would also still be subject to control.

Junior Institution of Engineers

Mr. G. W. Tookey was elected chairman of the Junior Institution of Engineers at the recent annual meeting. Other officers and members of Council elected were as follow:—Vice-chairmen, Mr. S. J. Crispin and Mr. P. B. Hebbert; hon. treasurer, Mr. S. H. Hole; hon. editor, Mr. W. N. S. Bevan; hon. librarian, Mr. J A. Roberts; members of Council: Mr S. R. Broderick, Mr. G H. Morgan, Mr. R. W. Winterborne, and Mr. R. S. Westley.

THE SCARCITY OF SCIENTISTS was a problem more vital than the shortage of raw material, said Dr. C. P. Snow, Fellow of Christ's College, Cambridge, when he opened new electrical laboratories at the County Technical College, Stafford. In Britain, he said, the number of people of scientific or technical professional standard was about 100,000; it ought to be double that number.

Personal

MAJOR-GENERAL J. A. M. BOND has been appointed a director of Pearson & Knowles Coal & Iron Company, Limited.

ADMIRAL SIR ARTHUR STRICKLAND has joined the board of Newman Industries, Limited, electrical and mechanical engineers, etc., of Bristol.

MR. H. W. HATTERSLEY has been appointed to the board of Dennis Bros., Limited, commercial motor and lawn-mower manufacturers, of Guildford, Surrey.

MR. A. F. BEACH has been appointed a director of the Halesowen Steel Company, Limited, Birmingham, in place of Mr. W. H. Spendlove, who died recently.

MR. H. W. BOSWORTH, chairman and managing director of Lancashire Dynamo & Crypto, Limited, is visiting the South African and Rhodesian offices and agencies of the company.

MR. THOMAS BLAKE EDWARDS has been appointed personal assistant to his father, Mr. T. H. Edwards, works manager of Ruston & Hornsby, Limited, engineers, boilermakers, etc.

SIR WILLIAM HALCROW and MR. W. J. E. BINNIE, past-presidents of the Institution of Civil Engineers, have been invested with the badge of Chevalier of the Légion d'Honneur by the French Ambassador.

MR. F. C. TOPLIS, general manager of Midgley & Son, Limited, iron and steel merchants, etc., of Sheffield, has been adopted as prospective Conservative-Liberal municipal candidate for the Park Ward of Sheffield.

MR. ASHLEY S. WARD, chairman and managing director of Thos. W. Ward, Limited, Sheffield, who is sailing for Australia on December 14, is to make a business tour for the group. He is expected to be away for five or six months.

MR. W. D. KENDALL, M.P., has relinquished his position as sales director and technical adviser of Newman Industries, Limited, electrical and mechanical engineers, etc., of Grantham, in order to devote more time to his political activities.

MR. R. W. PAYNE has been appointed manager of the Carron Company, ironmasters, etc., of Falkirk, in succession to the late Mr. A. C. Bernard. Mr. Payne is managing director of Smith & Wellstood, Limited, iron-founders, of Bonnybridge.

COL. T. G. GREENWELL, joint managing director of T. W. Greenwell & Company, Limited, shiprepairers, etc., of Sunderland, and COL. R. A. BARTRAM, managing director of Bartram & Sons, Limited, shipbuilders, of Sunderland, are two of the three nominees for the position of Sheriff of County Durham.

Wills

HALL, E. J., formerly for many years with Babcock & Wilcox, Limited, boiler manufacturers	£31,116
SANDERSON, C. P., late of C. P. Sanderson & Company, consulting marine engineers, etc., West Hartlepool	£24,773
MALCOLM, W. S., late managing director of the Coalbrookdale Company, Limited, ironfounders, etc., of Wellington, Salop	£31,801
DAVID, PROF. W. T., Professor of Mechanical Engineering at Leeds University, and formerly Professor of Mechanical Engineering at Cardiff	£16,755

Iron and Steel Subsidies

Amounts Paid During Last Three Years

Asked by Mr. Elwyn Jones whether he was in a position to give particulars of the amounts of any subsidies to iron and steel firms during the last three years, specifying the names of the firms and the amounts of the subsidies, Mr. G. R. Strauss, Minister of Supply, in a Parliamentary written answer, said that up to March 31, 1946, subsidies were paid through the medium of a Central Fund created during the war to stabilise iron and steel prices. The Central Fund was financed partly by the industry itself and partly from public funds, and the amounts paid from public funds to the individual companies could not, therefore, be accurately assessed. Details of direct subsidies paid to individual firms during the financial years 1946-47 and 1947-48 are given in the following tables.

Mr. Strauss stated that the greater part of the subsidies to the industry was paid in bulk in respect of (1) freight on foreign ore; (2) loss on imports of scrap, and (3) the difference between the import cost and sale prices of imported iron and steel. These imports were centralised, and it was impossible to assess the benefit derived by individual firms.

The Minister added that the payments were made to companies which were required either to undertake production unsuited to their capacity and therefore uneconomical, or to continue production which had ceased to be economic and would otherwise have stopped, to meet the need for maximum output in the types and of the qualities required.

TABLE I.—*Payments to Home Ore Producers to Secure Additional Production from Uneconomic Mines.*

Firm.	Amount paid from April 1, 1946, to March 31, 1947.	Amount paid from April 1, 1947, to March 31, 1948.	Total for 2 years.
	£	£	£
Barrow Hematite Steel Co. ..	34,825	29,926	64,751
Beckermet Mining Co.	89,386	107,138	196,524
Dorman, Long & Co.	336,373	410,933	747,306
Glamorgan Hematite Iron Co. ..	14,750	23,714	38,464
Hodbarrow Mining Co.	38,321	47,219	85,540
Millom & Askam Hematite Iron Co.	52,097	55,520	107,617
Pease & Partners	68,608	32,267	100,875
Skinningrove Iron Co.	—	47,994	47,994
Ulleoats Mining Co.	29,663	37,211	66,874
Total	664,023	791,922	1,455,945

TABLE II.—*Payments to Foundry Pig-iron Makers for the Production of Basic Pig-iron Essential for Steelmaking.*

Firm.	Amount paid from April 1, 1946, to March 31, 1947.	Amount paid from January 1, 1947, to March 31, 1948.	Total for 2 years.
	£	£	£
Staveley Coal & Iron Co.	3,209	10,186	13,395
Stanton Ironworks Co.	160,995	126,790	287,785
Total	164,204	136,976	301,180

TABLE III.—*Payment to Firm Required to Produce Coal Blast Pig-iron Outside its Normal Range to Meet the Essential Demand for this Quality.*

Firm.	Amount paid from March 31, 1946, to April 1, 1947.	Amount paid from April 1, 1947, to March 31, 1948.	Total for 2 years.
	£	£	£
Round Oak Steel Works	—	3,826	3,826

TABLE IV.—*Payments to Certain High-cost Producers of Basic Pig-iron Who Would Have Incurred Losses at the Controlled Price. These Subsidies have Now Ceased.*

Firm.	Amount paid from March 31, 1946, to March 31, 1947.	Amount paid from March 31, 1946, to March 31, 1947.	Total for 2 years.
	£	£	£
Brymbo Steel Co.	30,702	—	30,702
Goldendale Iron Co.	7,231	—	7,231
Shotts Iron Co.	73,970	469	74,439
Total	111,903	469	112,372

TABLE V.—*Payments for Abnormal Carriage Charges in Diverting Steel Ingots, Slabs and Sheet Bars, at the Direction of the Ministry, from Works which would Normally Use them to More Distant Works to Meet Essential Production Requirements.*

Firm.	Amount paid from April 1, 1946, to March 31, 1947.	Amount paid from April 1, 1947, to March 31, 1948.	Total for 2 years.
	£	£	£
Millom & Askam Hematite Iron Co.	1,172	1,597	2,769

A subsidy to the Phœnix Tube Company for heat-treatment of steel tubes for the ball-bearing industry to enable it to carry out this work at the controlled price. The amount was £3,555.

A subsidy to the Blaenavon Co. in respect of losses on the production of tyres, wheels and axles to maintain production from November, 1947, to January, 1948, pending consideration by the Government of the future of the company. The amount was £10,826.

Ironfoundries' Report

Mr. Arthur Lewis asked the Minister of Labour in the House of Commons if he had considered the report of the Joint Committee on Conditions in Iron Foundries; and what action he proposed to take to have the recommendation contained therein embodied in the Factory Act.

In the course of his reply, Mr. Isaacs said that he had considered the report. He had amended the Order under Section 1 of the Factories Act, as recommended by the Committee, and he understood that considerable progress had been made in the industry towards carrying out the other recommendations. He proposed at the end of the year to review the position and consider whether any further legislative action had been found to be necessary.

CLEVELAND METERS, LIMITED, Redcar, has secured a contract for 10,000 water meters for Malta.

British Blast Furnaces in the September Quarter, 1948

These tables are published through the courtesy of the British Iron and Steel Federation.

Derby, Leicester, Notts, Northants and Essex.

Name of firm.	In blast, October 2, 1948, making :—				Weekly average in blast.		Total built.	Furnaces relining.
	Hematite.	Forge and foundry.	Basic.	Total.	Sept. quarter.	June quarter.		
Clay Cross	—	1	—	1	1	1	2	—
Ford Motor	—	1	—	1	1	1	1	—
Kettering Coal & Iron	—	1	—	1	1	1	2	—
New Cransley Iron & Steel	—	1	—	1	1	1	2	1
Renishaw Iron	—	1	1	2	2	2	2	—
Sheepbridge Coal & Iron	—	1	—	1	1.6	2	1	—
Stanton Ironworks : Holwell	—	3	—	3	3	3	5	1
Stanton-by-Dale	—	5	—	5	5	5	5	—
Staveley Coal & Iron	—	4	—	4	4	4	4	—
Stewarts and Lloyds : Corby	—	—	4	4	4	3.7	4	—
Wellingboro' Iron	—	—	2	2	2	2	3	1
Total	—	18	7	25	25.6	25.7	31	3

Lancashire (excl. N.-W. Coast), Denbigh, Flint and Cheshire.

Brymbo Steel	—	—	1	1	1	1	1	—
Darwen & Mostyn	—	—	—	1*	1	1	1	—
Lancashire Steel Corp'n.	—	—	2	3†	3	3	4	1
Total	—	—	3	5	5	5	6	1

* Producing ferro-manganese. † Includes one producing ferro-manganese.

North-West Coast.

Barrow Hematite	1	—	—	1	1.9	1·9	4	1
Charcoal Iron	—	1	—	1	0.4	0.5	1	—
Millom & Askam	2	—	—	2	2	2	3	1
Workington Iron & Steel	2	—	—	2	2	2	3	1
Total	5	1	—	6	6.3	6.4	11	3

Lincolnshire.

Appleby-Frodingham	—	—	9	9	9	9	9	—
Lysaght, J. : Scunthorpe	—	—	3	3	2.5	2.8	4	1
Thomas, R., & Baldwins : Redbourn	—	—	2	2	2	2	2	—
Total	—	—	14	14	13.5	13.8	15	1

North-East Coast.

Cargo Fleet Iron	—	—	2	2	2	2	3	1
Consett Iron	1	—	1	2	2	2	2	—
Dorman, Long : Acklam	—	—	3	3	2.6	3	4	1
Redcar	—	—	2	2	2	2	2	—
Cleveland	—	—	3	3	3	3.2	5	—
Bessemer	—	—	3	3	3	3	3	—
South Bank	—	—	—	2*	2	2	4	—
Grangetown	—	—	—	—	—	—	2	—
Gjers, Mills & Co.	2	—	—	2	2	2	5	—
Pease & Partners	3	—	—	3	2.8	3	3	—
Skinningrove Iron	—	—	2	2	2	2	2	—
South Durham Steel & Iron	—	—	2	2	1.8	2	3	—
Total	6	—	18	26	25.2	25.2	38	2

* Producing ferro-manganese.

Scotland.

Baird & Scottish Steel : Gartsherrie	1	1	1	3	3	3	5	1
Carron	—	1	—	1	1	1	4	1
Colvilles	—	—	3	3	3	3	3	—
Dixon's	—	2	—	2	2	2	6	1
Total	1	4	4	9	9	9	18	3

International Nickel Statement

The report of the International Nickel Company of Canada, Limited, for the nine months ended September 30 shows a net profit, in terms of U.S. currency, of $29,920,873, after all charges, equivalent after preferred dividend requirements, to $1.95 a share on the common stock. This compares with a net profit of $23,522,911, or $1.51 a common share, for the corresponding period of last year.

Net profit for the quarter ended September 30 was $9,685,867, equal to 63 cents a share, compared with $9,819,301, or 64 cents a share, in the preceding quarter of 1948, and $7,062,572, or 45 cents a share, in the three months ended September 30, 1947.

Consolidated net sales for the third quarter were $50,215,855 and for the nine months $141,206,106, against $39,403,407 and $120,521,241. Operating profit was $16,894,482 and $52,115,160, as compared with $14,262,474 and $46,135,356. With other income $320,088 ($249,642) and $912,964 ($806,763) there is $17,214,570 ($14,512,116) and $53,028,124 ($46,942,119).

THE SOUTH WALES BRANCH of Cox & Danks, Limited, has moved from Swansea to a 9-acre site at Neath. As from Monday last the address is Scapa Works, Neath, Glam (telephone: Neath 2505/8).

Cargo Fleet's Modernisation Scheme

The Cargo Fleet Iron Company, Limited, Middlesbrough, has completed a scheme, which was begun two years ago, for the electrification and modernisation of its rolling mills. The company states that the scheme, running into some hundreds of thousands of pounds, has been financed from its own resources, and in the proposed method of take-over of the assets of the company, no credit will be given to the debenture holders and shareholders either for the expenditure of capital from their own resources or the initiative in modernising the rolling mills.

By this development, the company adds, it will be possible for a new 40-in. cogging mill to replace a steam-driven mill and smaller electrically driven bloom mill, and will enable formed blooms to be produced of a size ensuring a full range of broad-flange beams up to 24 in. by 12 in. to be rolled in the finishing mills. It will also ensure a more economic and larger production of rails, Larssen steel piling, and structural steel.

WILLIAM DOXFORD & SONS, LIMITED, Sunderland, is planning to transfer repair and reconditioning work from the main engine works at Pallion, to the Palmers Hill Engine Works, acquired after the war.

British Blast Furnaces in the September Quarter, 1948—*cont.*

Staffordshire, Shropshire, Worcestershire and Warwickshire.

Name of firm.	In blast, October 2, 1948, making:— Hematite.	Forge and foundry.	Basic.	Total.	Weekly average in blast. Sept. quarter.	June quarter.	Total built.	Furnaces relining.
Goldendale Iron	—	1	—	1	1	1	2	1
Grazebrook Cold Blast	—	—	—	—	—	—	2	—
Lilleshall	—	1	—	1	1	1	2	1
Round Oak Steelworks	—	1*	—	1	1	1	3	—
Shelton Steel & Iron	—	—	3	3	3	3	3	—
Stewarts and Lloyds: Bilston	—	—	2	2	2	2	3	1
Thomas, G. & R.	—	—	—	—	—	—	2	—
Total	—	3	5	8	8	8	17	3

* Cold-blast pig-iron.

South Wales and Monmouthshire.

Guest, Keen, Baldwins: Briton Ferry	1	—	—	1	1	0.7	1	—
Cardiff	2	—	1	3	3	3	4	1
Steel Co. of Wales: Margam	—	—	2	2	1.9	2	2	—
Thomas, R., & Baldwins: Ebbw Vale	—	—	1	1	1.9	2	3	1
Total	3	—	4	7	7.8	7.7	10	2

Sheffield.

Park Gate Iron & Steel	—	—	1	1	1	1	2	—
GRAND TOTAL	15	26	56	101*	101.4	101.8	148	18

*Includes four making ferro-alloys.

Number of Furnaces in Blast on October 2, 1948

District.	Weekly average in blast, Sept. quarter.	Total in blast, Oct. 2, 1948.	In blast October 2, making:— Hematite.	Forge and foundry.	Basic.	Ferro-alloys.
Derby, Leics., Notts., Northants and Essex	25.6	25	—	18	7	—
Lancs. (excl. N.-W. Coast), Denbigh, Flint and Ches.	5	5	—	—	3	2
Lincolnshire	13.5	14	—	—	14	—
North-East Coast	25.2	26	6	—	18	2
Scotland	9	9	1	4	4	—
Staffs., Shrops., Worcs. and Warwick	8	8	—	3	5	—
S. Wales and Monmouth	7.8	7	3	—	4	—
Sheffield	1	1	—	—	1	—
North-West Coast	6.3	6	5	1	—	—
Total	101.4	101	15	26	56	4

Weekly Average Number of Furnaces in Blast during the Previous Six Quarters

District.	1948. June.	March.	1947. Dec.	Sept.	June.	March.
Derby, Leics., Notts., Northants and Essex	25.7	25.4	24.3	25.8	23.6	24.7
Lancs. (excl. N.-W. Coast), Denbigh, Flint and Ches.	5	5	4.7	3.9	4	3.9
Lincolnshire	13.8	13.7	13	11.4	10.2	11.6
North-East Coast	25.2	25.7	25	23.7	23.7	25.5
Scotland	9	9.1	8.5	8	8	10.2
Staffs., Shrops., Worcs. and Warwick	8	8	7.1	6.2	4.4	4.2
S. Wales and Monmouth	7.7	7	6.9	6.9	6.9	6.9
Sheffield	1	1	1	1	1.8	1
North-West Coast	6.4	7	7	6.3	6.4	6.8
Total	101.8	101.9	97.5	93.2	89	94.7

The following companies have furnaces in course of construction:—Darwen & Mostyn, 1; Lancashire Steel Corporation, 1; Steel Co. of Wales, 1; Sheepbridge Coal & Iron, 1; Consett Iron, 1, and Skinningrove Iron, 1.

News in Brief

OF THE 1,882 registered students at Sheffield University, 203 are reading engineering and 102 metallurgy.

MR. ALBERT HICKEY, managing director of J. Hickey & Sons, Limited, boilermakers, of Richmond, Surrey, who died on September 11 last, intestate, left £37,561.

SAMUEL FOX & COMPANY, LIMITED, Sheffield, is to join with Firth-Vickers Stainless Steels, Limited, Sheffield, in the building and working of a new £1,500,000 stainless-steel rolling mill for which a site has been acquired at Tinsley, Sheffield.

DORMAN, LONG & COMPANY, LIMITED, is re-instituting safety weeks at its several Tees-side works. Before the war, as a result of special campaigns, there was progressive reduction in works accidents, but an appreciable increase took place during the war.

A £350,000 CONTRACT for furnaces to be installed at the continuous wide-strip mills of the Steel Company of Wales, Limited, Port Talbot, has been secured by the Incandescent Heat Company, Limited, Smethwick. The furnaces will have a combined capacity of 7,000 tons a week.

HEAD, WRIGHTSON & COMPANY, LIMITED, Seaton Carew, Co. Durham, has received delivery of an anvil weighing 110 tons which is to be used as part of a drop hammer for making forgings for the oil industry. The anvil was towed by road from Buckinghamshire by two 240-h.p. tractors.

AN ORDER for what is claimed to be the largest metallic loading resistance unit ever made has been completed at West Hartlepool by the Expanded Metal Company, Limited, for a Continental organisation. The device, which can deal with 25,000 h.p., is to be used for testing heavy-duty equipment in connection with railway electrification.

THE ANNUAL REPORT of Herbert Morris, Limited, manufacturers of lifting and transporting machinery, of Loughborough, states that the directors "do not rule out the possibility of profitably using further additional capital." The chairman explains that E.P.T. refunds, which have not yet been applied for, will not be sufficient to pay for developments.

SOME 16 BRITISH COUNCIL SCHOLARSHIPS out of a total of 359 new awards and extensions for the academic year 1948-49 have been awarded to scholars studying engineering subjects. The scholarships are awarded to overseas graduates or to others of like status to enable them to undertake a year's specialist study at a British university, college, hospital, or other educational institution.

SIR PERCY H. MILLS, managing director of W. & T. Avery, Limited, Soho Foundry, Birmingham, is the president of the newly formed Institute of Industrial Supervisors, which is described as being a national educational body for foremen and supervisors on similar lines to the existing professional institutions. Mr. A. J. Mansell, Bank Chambers, 47, Temple Row, Birmingham, 2, is the general secretary.

THE FIRST all-aluminium bascule bridge in the world was opened at South Dock, Sunderland, on Friday, by the Minister of Transport (Mr. Alfred Barnes). Spanning 90 ft. of water across the junction of the Hudson and Hendon Docks, the structure weighs only 54 tons and will carry heavy rail and road traffic. A 25-h.p. electric motor can raise the two halves of the bridge in about a minute.

BRISTOL'S INSTRUMENT COMPANY, LIMITED, West Twyford, London, N.W.10, is to move to a new factory at Weymouth, Dorset, on December 10. The new factory will facilitate an immediate increase in production far in excess of the capacity of the London works. A portion of the London premises will be maintained as an office, but all manufacturing and administrative functions will take place at Weymouth.

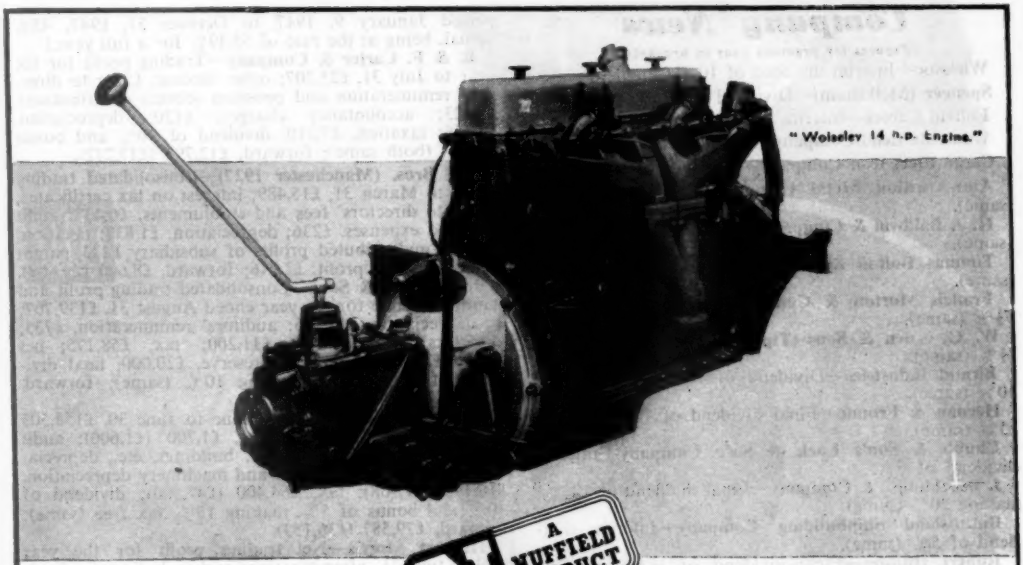
MARINE ENGINEERING EXPERTS from the Scottish shipbuilding centres and from Tyneside visited the Greenock works of John G. Kincaid & Company, Limited, on November 22, to see the running tests of the first Kincaid-Polar Diesel engine, M.T. type. The machinery is intended for installation in El Halal, the first of two 12-knot cargo motorships building by the Ardrossan Dockyard, Limited, for Halal Steamship Company, Limited.

IN CONJUNCTION with the firm's associate company in America and following 15 months' preparation and the expenditure of £50,000 on reorganisation and new equipment, Wailes Dove Bitumastic, Limited, Hebburn, has begun the production of a new iron and steel protective which, it is hoped, will earn valuable dollars and create many new jobs. The company's first order, valued at £70,000, is for the coating of 660 miles of oil pipeline in the Near East; other orders are expected for other pipeline schemes.

THE SUCCESS of the first International Trade Fair held at Toronto earlier this year has prompted the organisers, the Canadian Government Exhibition Commission, to make the Fair a regular event. It will accordingly be held again in the same buildings from May 30 to June 10, 1949. Full details are obtainable from the Commission's representative in London, Miss M. A. Armstrong, Canada House, Trafalgar Square, S.W.1. Applications for space in the 1949 Fair must be in by December 31, 1948.

THE COMMISSIONERS OF CUSTOMS AND EXCISE have decided that the following articles shall be regarded as within the scope of Group 11 (i) of the Tax Schedule and as not subject to tax:—Enamelled jugs, of household pattern, which are of a shape and style obviously suitable for containing drink, and are either (*a*) graduated, or (*b*) if ungraduated, are of a capacity between ½ pint and 8 pints, inclusive. Tapering-sided "unbellied" jugs of the type known as French ewers remain taxable at the rate of 33⅓ per cent. under Group 11 (*a*).

APPLICATION HAS BEEN MADE for Treasury sanction to a new capital issue by Spurling Motor Bodies, Limited. It is proposed to create 250,000 5 per cent. £1 redeemable cumulative preference shares and to issue 150,000 of them to ordinary stockholders. The price of issue is "dependent on market conditions," but is expected to provide approximately £150,000 in cash after all expenses. Proceeds will be used to provide improved plant and equipment and to purchase additional premises, estimated together to cost about £105,000, and for working capital. An extra-ordinary meeting will be held on December 15.



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ENGINEERING CASTINGS

THE STANTON IRONWORKS COMPANY LIMITED, Nr. NOTTINGHAM

Company News

(Figures for previous year in brackets.)

Whessoe—Interim dividend of 10% (same).

Spencer (Melksham)—Dividend of 12½% (same).

Enfield Cables—Interim dividend of 3½% (same).

Weardale Lead Company—Dividend of 10% (5%).

Cargo Fleet Iron Company—Dividend of 5% (same).

Anti-Attrition Metal Company—Dividend of 10% (same).

H. J. Baldwin & Company—Interim dividend of 10% (same).

Thomas Bolton & Sons—Interim dividend of 2½% (same).

Francis Morton & Company—Interim dividend of 7½% (same).

W. G. Allen & Sons (Tipton)—Interim dividend of 2½% (same).

Birmid Industries—Dividend of 10% and bonus of 10% (same).

Heenan & Froude—Final dividend of 10%, making 15% (same).

Chubb & Son's Lock & Safe Company—Interim dividend of 5%.

J. Brockhouse & Company—Final dividend of 12½%, making 20% (same).

Burntisland Shipbuilding Company—Interim dividend of 5% (same).

Robert Hudson—Final dividend of 18¾%, making 37½%. The company was made public last June.

Indian Iron & Steel Company—Dividend of 12 annas (6 annas) per share, *i.e.*, 7½% (3¾%), free of Indian income tax.

Wire Industries, Steel Products & Engineering Company—Interim dividend of 12½% (equal to 7½d. per share) on increased capital.

South Durham Steel & Iron Company—Dividend of 10% (8¾%) on the "A" ordinary shares and of 4% (2½%) on the "B" ordinary shares.

Burco—Net profit to September 30, £42,890 (£50,429); to reserve, £19,000 (£30,500); dividend of 35% (same); forward, £20,327 (£20,224).

Linotype & Machinery—Payment of 12% on account of arrears on the 6% preference shares for the two years to April 11, 1928 (similar payment a year ago).

Engineering & Lighting Equipment Company—Net trading loss to March 31, £11,785 (loss £35,396); no dividend on the ordinary and preference shares (same).

Associated Fire Alarms—Profit to June 30, £4,242 (£2,182); to income tax and profits tax, £2,114 (£916); dividend of 4%, less income tax at 9s., £1,258 (same); forward, £2,583 (£1,714).

Shelvoke & Drewry—Profit to July 31 £18,838 (£28,027); dividend of 7½% (10%); to tax, £9,000; credit for taxation over-provided in previous years, £2,462; forward, £34,840 (£31,306).

Wilkes—Net profit, before tax, to July 31, £7,768 (£3,779); to tax, £3,951 (£1,832); leaving £3,817 (£1,947); to directors' fees, £600 (same); dividend of 10% (same); forward, £5,530 (£3,689).

Midland Bright Drawn Steel & Engineering Company—Final dividend of 35%, making 55%. (Trading period January 9, 1947, to October 31, 1947, 45% actual, being at the rate of 55.49% for a full year.)

B. & F. Carter & Company—Trading profit for the year to July 31, £25,207; other income, £221; to directors' remuneration and pensions scheme contributions, £7,423; accountancy charges, £120; depreciation, £4,456; taxation, £7,910; dividend of 10% and bonus of 5% (both same); forward, £12,791 (£17,272).

Bell Bros. (Manchester 1927)—Consolidated trading profit to March 31, £15,489; interest on tax certificates, £276; to directors' fees and emoluments, £6,437; audit fees and expenses, £236; depreciation, £1,837; taxation, £3,866; undistributed profits of subsidiary, £473; parent company's net profit, £2,916; forward, £8,600 (£9,809).

John Rigby & Sons—Consolidated trading profit and sundry revenue for the year ended August 31, £139,707; to depreciation, £14,745; auditors' remuneration, £735; directors' remuneration, £11,200; tax, £58,175; net profit, £54,853; to general reserve, £20,000; final dividend of 5% (7½%), making 10% (same); forward, £53,548 (£32,445).

Yarrow & Company—Revenue to June 30, £158,503 (£118,124); to directors' fees, £1,700 (£1,600); audit charges, etc., £1,234 (£1,221); buildings, etc., depreciation, £9,036 (£6,433); plant and machinery depreciation, £16,199 (£7,908); tax, £64,400 (£47,500); dividend of 10% and bonus of 5%, making 15%, tax free (same); forward, £79,587 (£36,153).

Herbert Morris—Net trading profit for the year ended July 31, after taxation, and including dividends from subsidiary companies, and interest on Government securities, £152,674 (£131,724); to general reserve, £55,000 (£10,000); final dividend of 15%, tax free, and bonus of 2%, tax free, making 22%, tax free (same); forward, £62,872 (£83,055).

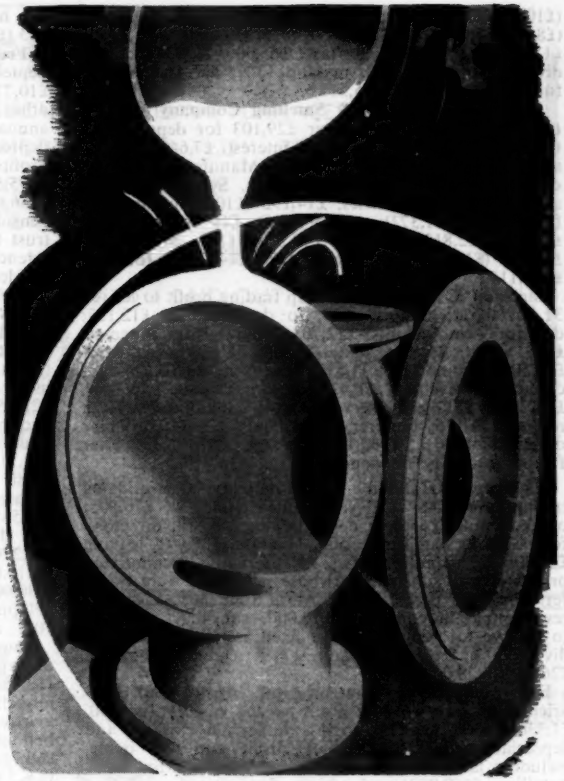
Cannon Iron Foundries—Profit to June 30, after all expenses, £265,620; to taxation (including income tax payable January 1, 1950), £146,332; leaving £119,288; to dividends already paid on preference and ordinary shares, £13,200; available, £138,210; to final ordinary dividend of 10%, making 15% (same), £14,300; general reserve, £64,886; forward, £59,024 (£32,122).

Brett's Stamping Company—Trading profit for the year to July 31, £67,170 (£23,645); E.P.T. repayable, nil (£6,000); other income, £338 (£944); to taxation, £28,712 (£9,652); depreciation, £3,580 (£3,135); directors' remuneration, £9,255 (£6,190); audit fee, £113 (£115); net profit, £25,848 (£11,407); war damage compensation and interest, £2,491 (nil); dividend of 20% (same); forward, £39,228 (£18.149).

E. W. Tarry & Company—Trading profit for the year to March 31, £143,582 (£143,768); other income, £322 (£40); to tax, £74,675 (£92,079); depreciation, £6,674 (£5,080); directors' fees, £1,520 (£1,320); net profit, £61,035 (£45,329); ordinary dividend (including 100,000 £1 shares issue last spring) of 15% (same); stock contingencies, £20,000 (£15,000); staff pension fund, £5,000 (same); general reserve, nil (£10,000); forward, £21,553 £11,093).

Dowty Equipment—Trading profit of the parent company for the year ended March 31, after all manufacturing expenses, etc., including provision for depreciation, audit fee, directors' emoluments, £105,982

THE UNITED STEEL COMPANIES LTD



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(£108,812); income from Government securities, £12,843 (£837); interest receivable, £3,815 (£3,089); net profit, £122,640 (£112,738); to tax, £65,000 (£70,000); final dividend of 3% (7%), making 13%, tax free (same); forward, £147,153 (£115,513).

Electrolytic Refining & Smelting Company of Australia—Working profit, after £29,103 for depreciation, to June 30, £41,112 (£10,470); interest, £7,640 (£3,549); sale of plant, nil (£375); Metal Manufacturers' dividend, £38,500 (nil); to Melbourne, Sydney, London, and New York expenses, £14,192 (£10,155); directors' fees, £2,050 (£1,372); sale of plant, £44 loss (nil); tax, £22,689 (£2,813); leaving £48,277 (£54); brought in, £80,840 (£127,500); to dividend, nil (£46,714); forward, £129,117.

Incledon & Lamberts—Group trading profit to March 31, £160,571; interest, £30; to depreciation, £12,137; directors' emoluments, £12,703; capital issue expenses, £69; South African tax, £22,193; U.K. profits tax, £15,500; income tax, £31,337; net profit, £66,662; parent company's revenue, £70,429; to capital issue expenses, £69; tax, £31,697; reserve, £1,614; capital redemption reserve, £1,125; preference dividends, £2,184; ordinary dividend of 20%, £16,819; forward, £837 (£735), after further ordinary dividend of 20%, £16,819.

Pickford, Holland & Company—Consolidated trading profit for the year ended June 30, £76,805; other income, £655; to depreciation, £16,512; directors' fees, £1,452; staff fund, £500; taxation, £27,991, leaving £31,005; to capital reserve, £1,508, being accumulated profits of two subsidiaries whose net assets were transferred to the parent company on June 30; to general reserve: parent company, £10,000, subsidiary, £4,726; to reserve for replacement of fixed assets, £7,500; final dividend of 10%, making 17½% (same); forward, £26,545 (£28,044).

Electrolytic Zinc Company (of Australasia) Proprietary—Gross working profit for the year to June 30, £1,336,489 (£1,536,843); to reserve for amortisation and depreciation, £300,000 (same); profit and loss items, including land tax, income tax and provision for latter (totalling £460,000) and reserve for mine depreciation (ore depletion) of £50,000, £519,647 (£609,750); net profit, £516,842 (£627,093); to dividend No. 51, £180,000 (same); appropriation for dividend No. 52, £270,000 (£345,000); new plant and development, West Coast Mines, expended during year, £14,463 (£15,217); reserve, £50,000 (£85,000); forward, £219,364 (£216,985). Total dividends on preference and ordinary (already announced), 15% (17½%).

Broken Hill South—Mine production for the year ended June 30, £2,995,062 (£2,764,678); to mine expenditure, £1,391,615 (£1,116,449); railage on lead and zinc concentrates, £151,558 (£113,528); administrative expenses, £24,481 (£20,745); donations, nil (£16,250); taxes, £422,500 (£789,000); royalty, £150,000 (£157,230); depreciation, £33,000 (same); outside mining expenditure, £46,230 (£17,569); leaving £775,678 (£500,907); net profit from investment section, £140,568 (£149,273); appropriation for new plant, etc., less expenditure, £136,884 (£37,029); investment profit, nil (£801); surplus from liquidation of Broken Hill Co-operative Coal, £43 (nil); to dividends, £240,000 (£120,000); appropriation for new plant, etc., £150,000 (same); general reserve, £43 (£801); forward, £879,619 (£517,489).

Frederick Braby & Company—Profit on trading to September 30, £572,095; dividends and interest (gross), £10,773; to interest, £4,360; to directors' fees, £3,000; other services, £20,146; pensions, £2,216; staff superannuation, £9,644; employees' participation, £37,100; depreciation of fixed assets, £42,646; audit, £1,200; profits tax, £60,500; income tax, assessable 1949-50, £195,500; net profit, £206,556; to general reserve, £156,645; debenture redemption, £7,500; workmen's pension, £85,000—less balances of redundant insurance trust funds £82,049—leaving £2,951; dividends on preference and employees' stock, £13,930; final ordinary dividend of 1s. 6d., making 2s. (same); "additional" on employees' stock of 7.2d., bonus of 6d., and special bonus of 6d. on the ordinary shares (same); forward, £63,814 (£64,930).

Crittall Manufacturing Company—Consolidated trading profit to August 31, £518,002 (£517,272); income from investments, £52,630 (£24,248); interest, £2,675 (£3,137); to depreciation, £75,255 (£93,269); auditors' remuneration, £1,650 (£1,350); mortgage loan interest, £55 (£170); E.P.T., nil (£19,906); profits tax, £77,219 (£59,734); income tax, £169,617 (£175,762); net profit of group, £249,511 (£227,646); to profits of subsidiaries attributable to outside shareholders, £9,191 (£7,565); profits attributable to Crittall Manufacturing not distributed by subsidiaries consolidated, £21,192 (£4,270); net profit of company for the year, £219,128 (£215,811); to extension of pension schemes, nil (£80,000); written off amount owing by Silver End Development Company, £41,273 (nil); final dividend of 10%, making 20% (same); forward, £159,111 (£91,944).

Dorman, Long & Company—Consolidated accounts to September 30 show:—Profits on trading, £4,118,442 (£2,934,272); investment income, £44,334 (£35,208); miscellaneous income, £56,825 (£41,540); to interest on loan capital, £53,411 (£50,813); sinking fund 4% prior lien stock, £8,153 (£7,845); directors' emoluments, £60,724 (£62,741); depreciation, £1,002,225 (£663,743); U.K. tax, £1,790,127 (£1,284,034); leaving £1,304,961 (£941,844); to profits of subsidiaries applicable to outside shareholders, £86,487 (£31,518); undistributed profits of subsidiaries applicable to parent company, £136,897 (£71,563); net profit to parent company's profit and loss account, £1,081,577 (£838,763); to general reserve, £750,000 (£500,000); dividends: 1st preference £102,172, 2nd preference £29,169, preferred ordinary £22,580, further 8% on preferred ordinary £22,580, 8% on ordinary £153,171 (all same); forward, £104,224 (£102,319).

LICHFIELD CORPORATION PLANNING COMMITTEE has approved an outline plan for the redevelopment of the Phœnix Foundry of Chamberlin & Hill, Limited.

RESPONSIBILITY FOR glass sand and foundry moulding sand has been transferred from the Raw Materials Department of the Board of Trade to the Ministry of Works. Inquiries should be addressed to Ministry of Works, B.M.3, Lambeth Bridge House, Albert Embankment, London, S.E.1.

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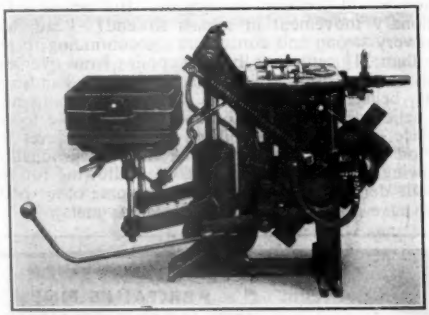

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Raw Material Markets

Iron and Steel

Foundrymen are still confronted with endless difficulties arising from the shortage of pig-iron. The need for an increase in the output of high-phosphorus iron has long been apparent, but the recruitment of extra labour and the provision of the necessary raw materials are tasks which must first be accomplished before even one more blast furnace can be put into operation. This is a problem which is receiving close attention, and it is hoped that a satisfactory solution may not be much longer delayed. Meanwhile, deliveries to the light foundries are severely restricted, and, to a lesser degree, the stringency also extends to hematite and low- and medium-phosphorus irons. Consequently, there has been a quickening in the demand for refined iron, of which good supplies are available.

Quite a number of the re-rolling plants find their operations restricted owing to the lack of suitable material. Improvement in deliveries seems to be confined to the larger sizes of billets, blooms, etc., and mills using these classes of material are busily engaged. But the scarcity of small billets for the production of small bars, strip, and light structural sections is still a matter of serious concern. Sheet-makers, too, are constantly pressing for additional tonnages of sheet bars and, although imports of Belgian semis are on a better scale, re-rollers generally are keen to acquire defective material to make good the deficiencies in the supply of prime billets and sheet bars.

Rollers of plates, joists and sections are running their mills to the limit of capacity in an all-out effort to clear off their heavy commitments before the end of the year. Already they have extensive bookings for the first half of 1949, and both on home and export account more business is on offer. The motor trade has been promised a very small increase in the steel allocation after the end of the current period, but shipbuilders have received no such encouragement and are resentful of the fact that supplies, of which they are in urgent need, are being shipped to their competitors in Sweden, Holland, Norway and Denmark. Pressure for railway and colliery equipment is unabated, and strip and wire mills, working to capacity, are likely to continue under similar conditions for the whole of next year.

Non-ferrous Metals

The most interesting development in the non-ferrous metal trade last week was the advance of 2 cents in the American price of zinc to 17½ cents per lb., which has a sterling equivalent of about £97 per ton and must, therefore, in due course compel an increase in the Ministry of Supply price in this country. It will be remembered that the ruling figure in the United Kingdom to-day is £92 per ton, to which figure the Ministry of Supply advanced its selling limit on October 1 last; but what this latest increase in the world price will mean in Britain remains to be seen. The outlook for supplies of "Prime Western" quality zinc does not seem to be too good and this, coupled with the extremely high cost of the metal, must be having its effect on the value. Aluminium, which is to-day available at the very moderate figure of £87 per ton, is a standing rival both to copper and zinc and will inevitably tend to oust the heavier metals as time goes on. Zinc before the war was available at £15 per ton, or even less, and when in the New Year consumers are asked to pay over £100 per ton (as they almost certainly will be), it must be expected that consumption will decline.

A very difficult situation exists in copper on the United States market, for the strike at the Utah mine of the Kennecott Company still continues and the production of many thousands of tons has been lost since the dispute began. In consequence, supplies of copper are very meagre and the metal is reported to have changed hands at up to 28 cents per lb., compared with the ruling figure on the domestic market of 23½ cents. It is reported in America that there is considerable pressure in an upward direction, but it is known that the big producers are opposed to any further advance in the copper quotation, for this will only lead to a demand for higher wages on the part of the miners. But in metal circles it is doubted whether the policy of holding copper down at 23½ cents per lb. can succeed and an upward revision would occasion no surprise. But where is this inflationary movement in metals to end? Lead, too, seems very strong and consumers are continuing to pay more than 21½ cents per lb. for supplies from overseas. In this country users are not unaware of the handsome profits being earned by the tin-mining companies. It is believed that the tin producers would like to see the price of the metal stabilised at its ruling level for a period of years, but in view of the way production is growing, it would appear that, even allowing for the stockpile demand, the Government or some other body would have to step in and buy surplus metal.

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